

# Popular Mechanics



**WIN**

3 YALE DATA FIRE  
SAFES VALUED  
AT OVER  
R10 000!

DECEMBER 2014  
RSA: R34,90

Other countries:  
R30,61 excl VAT

## THE 2014 BREAKTHROUGH AWARDS

3-D printed car

Prefab skyscrapers

The most human  
robot ever

Super-lightweight  
Marine packs

Welcome to our annual celebration of people, ideas, and things that made an impact, like this Nasa research vessel that orbited the Moon for 100 days before crashing into the lunar crust (on purpose), a mission that could propel mankind deeper into space.

### SKILLS

- COOK YOUR ENTIRE XMAS MEAL ON THE BRAAI
- HOW TO CUT ANYTHING
- MAKE A FARMHOUSE TABLE

**PARIS  
MOTOR  
SHOW**  
FASHION MEETS  
FAR-OUT

EXCLUSIVE  
THE SCIENTIST  
WHO CREATED A  
DEADLY FLU VIRUS  
(but why?)

FREE  
INSIDE  
COOL STUFF  
GUIDE



**TESTED**  
TOMTOM SPORTSWATCH  
CARMATE HANDS-FREE

**CHASING THE SUN**  
SOLAR CHALLENGE: TRIUMPH AND TEARS







#### SMART TECHNOLOGY

- 800mm water wading
- Traction Control
- Advanced Shift-On-The-Fly



Model shown with optional sports bar.



[www.ford.co.za](http://www.ford.co.za)  
Visit FordSouthAfrica



Quality



Green



Safe



Smart

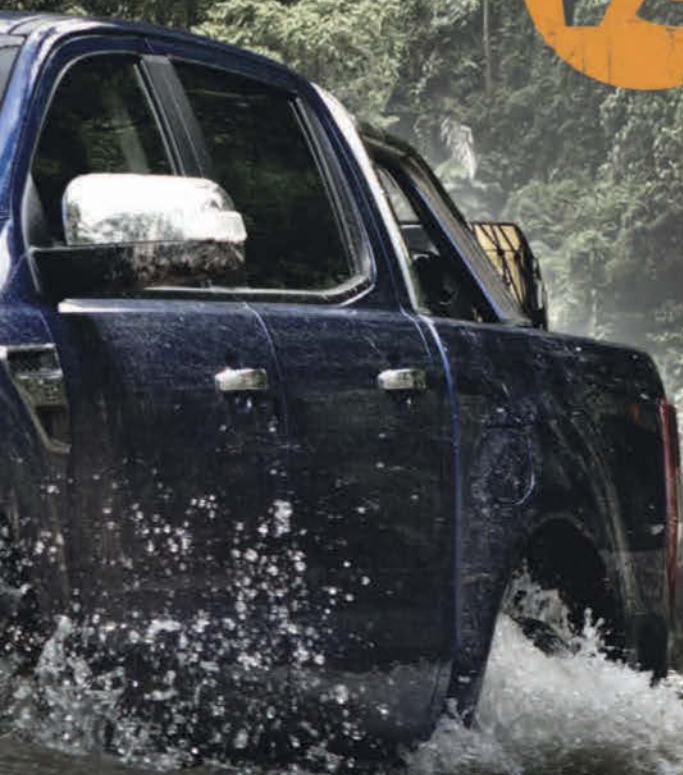


New

**RANGER**



**TOUGH  
TERRAINS.**



# CONTENTS

**Popular  
Mechanics**

DECEMBER 2014 VOL 13, NO 5 | BE THE FIRST TO KNOW

## How your world works

- 16 How to study an asteroid:** what's it like, landing on a comet?  
**The missile bubble:** How the Iron Dome defends Israel  
**The genius face off:** Alan Turing and Stephen Hawking go to the movies  
**Science saves art:** restoration "repainted" with light  
**Headphones that can fix your music:** an amp where you need it  
**Making a good beer better:** sometimes the problem's the packaging, not the contents  
**Great unknowns:** why sheltering between railway tracks is a bad idea

## Tech

- 82 Chasing the Sun**  
What makes – and breaks – a Sasol Solar Challenge contender

## Features

- 35 Breakthrough Awards**  
Our annual celebration of amazing people and innovations that have changed our lives  
**62 A beautiful thing**  
An axe that helped build a nation  
**64 FutureTech 2014**  
All abuzz over bees  
**73 Coming soon**  
Mind-controlled quadcopters, anyone?

## Science

- 54 The man who could destroy the world**  
Recreating a deadly virus... to save us?

## Wheels

- 74 Paris Motor Show:** glitz, glamour and great ideas  
**Land Rover Discovery Sport:** compact, yet roomy  
**Jaguar XE:** opportunities up ahead

## Tested

- 28** • TomTom Runner Cardio sports watch  
• JUD500 ultrastation  
• Carmate Pro hands-free kit  
• Logitech Z333 multimedia speakers

## Upgrade

- 66 Amphibious house:** home and dry  
**World's biggest EV:** bendy bus with a difference  
**Mass Fidelity Core:** stereo from mono?

## Skills

- 88 Christmas lunch on the grill:** talking turkey... and all the trimmings  
**How to cut anything:** from tiles to trout, our sharpest tips  
**A table for everyone:** farmhouse furniture made easy  
**Ask Roy:** grease stains and a problematic paint job

## Monthly

- 4** Contact us  
**6** Editor's notes  
**10** Letters  
**14** Time machine  
**112** Do it your way

**Cover caption:** Nasa's remarkable, cost-cutting modular Ladee lunar orbiter performed flawlessly – right up to the time it was deliberately crashed into the Moon's surface.

**This page:** Not all Sasol Solar Challenge contestants are created equal, Sean Woods finds in Chasing the Sun (see Page 82).



16

35







**SUBSCRIBE,  
SAVE 25%  
AND GET**  
a Cape Union  
Polaris LED  
torch. See inside  
back cover for details.



**WIN!**

1 of 3 Yale  
data fire  
safes, each  
worth over  
R10 000 (see  
page 71)



**TESTED** 28



35



62



88



65



► SUBSCRIBE NOW!

# Popular Mechanics

BE THE FIRST TO KNOW

EDITOR: Anthony Doman GROUP PUBLISHER: Neil Piper

## EDITORIAL TEAM

Associate editor Sean Woods  
Digital content manager Kate Simons

## PRODUCTION AND CREATIVE TEAM

Group production manager Keryn Rheeder  
Production manager Gronja Lennox  
Art director Thea Woodman  
Designer Sharon Gunst  
Group smalls designer Relic Wessels  
Group developer Cicero Joseph  
Group digital designer Colleen Visser

## BUSINESS AND SALES TEAM

Group national sales manager André Stadler  
Group digital business manager Wendy Lucas  
Sales manager Jesse Henney  
Advertising sales executives Gauteng – Joanne Thompson, Patrick Kennedy, Nicky Lloyd, Jackie Browning  
Durban – Lindi van den Heever  
Cape Town and PE – Ingrid Versfeld  
Advertising sales co-ordinator Linda Delpoit  
Group marketing services analyst Thembi Mokoena  
Campaign managers Nawhaal Fakir  
Yumna Galvaan

## MARKETING, EVENTS AND CIRCULATION

Group marketing and sponsorship manager Dean Dicks  
Group show manager Richard Falconer  
Group promotions manager Channele Vivian  
Audience development manager Katherine Miller  
Promotions manager Amanda Africa  
Group circulation and marketing designer Robyn Shield  
Group show and events operations manager Kathryn Frew  
Group show and events sales consultant Hanneke van Niekerk  
Subscriptions operations Karin Mulder  
Subscriptions administration Lynn Heiberg  
Contact centre manager Gregory Esau



## GROUP SUPPORT

Chief operations officer Werner Schmidt  
Finance manager Zafre Gorgosilich  
HR officer Emmelia Fouché  
IT manager Alex Chetty

## DIRECTORS

Paul Jenkins (Chairman), Tim Holden, Terry Moolman, Neil Piper, Werner Schmidt, Cornelios Vamvadelis

## PUBLISHED BY RamsayMedia (PTY) LTD

Company registration number: 1934/005460/07 ISSN number: 1682-5136

Cape Town head office: Uitvlugt, 3 Howard Drive, Pinelands, 7405  
P O Box 180, Howard Place, Western Cape, 7450

Tel: 021 530-3100, Fax: 021 531-9495

Gauteng office: Caxton House, 368 Jan Smuts Avenue, Randburg, 2196

P O Box 78132, Sandton, Gauteng, 2146

Tel: 011 449 1100, Fax: 011 449 1104

Email address: [popularmechanics@ramsaymedia.co.za](mailto:popularmechanics@ramsaymedia.co.za)  
[www.ramsaymedia.co.za](http://www.ramsaymedia.co.za)

## HOW TO SUBSCRIBE OR CONTACT US

Call: 0860 100 205, Fax: 0866 704 101 or 021 530 3143,

E-mail: [subs@ramsaymedia.co.za](mailto:subs@ramsaymedia.co.za)

Online: [www.magsathome.co.za](http://www.magsathome.co.za) or [www.popularmechanics.co.za](http://www.popularmechanics.co.za)

Web site: [www.popularmechanics.co.za](http://www.popularmechanics.co.za)

FOR OUR CURRENT SUBSCRIPTION RATES, SEE INSIDE BACK COVER

Published and distributed by RamsayMedia (Pty) Ltd by permission of Hearst Communications Inc, New York, New York, United States of America.

We cannot be responsible for loss of unsolicited queries, manuscripts or photos. For return, they must be accompanied by adequate postage. As a service to readers, POPULAR MECHANICS publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, POPULAR MECHANICS cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from information published in this magazine.

abc Total monthly sales: 38 081 (April-June 2014)

[www.popularmechanics.co.za](http://www.popularmechanics.co.za) • DECEMBER 2014



ACCESS ANY TIME,  
ANYWHERE.

Visit [www.popularmechanics.co.za/subscribe](http://www.popularmechanics.co.za/subscribe)

Single issues are also available.

Be sure to rate & review us!



This offer closes 31 December 2014. Other subscription gifts and prizes do not apply to this offer. By providing your details, you give Popular Mechanics permission to communicate with you via email or SMS.



  
MICHEL  
**HERBELIN**  
MONTRES DE LUXE FRANÇAISES



QUALITY IS IN THE DETAIL  
ART IS IN THE SOUL

From the Michel Herbelin Newport Collection, a carefully crafted timepiece combining elegance and strength for the outdoors. Featuring a Swiss Chronograph Movement. Stainless Steel Case and Bracelet with Rose Gold PVD Plating. Sapphire Crystal Glass. Water Resistant to 100M.



# CHANGE IS GOOD. SO IS TRADITION



**New kid on the block? Nah, familiar face. Anthony Doman is PM's second editor.**



**Mark Collins (left) and Greg Aberdeen are our Inventors of the Year. See page 64.**

## COMPETITION WINNERS...

Details online at [www.popularmechanics.co.za](http://www.popularmechanics.co.za)

**AS ONLY THE SECOND OCCUPANT OF THE EDITORIAL CHAIR** in the 12-plus years since **POPULAR MECHANICS**'s South African edition was established – and having been here since Day One myself – I am acutely aware that continuity has served us well. I am not so much being given a licence to assume control of editorial direction, as being handed a baton.

Because, as much as change is deemed to be a good thing, here at PM we're big on tradition. The tradition of innovation. Of enquiring minds. Of being the first to know. Whatever else may change, those are the kinds of traditions we'll continue to uphold.

But inevitably there will be change. Speaking of which, as you can see from the image alongside, the new guy wears a tie. (Sometimes.) He also wears jeans. (Habitually.) As many of you know by now, he finds cars fascinating, but has a mild obsession with bicycles – and an enduring love affair with the guitar. Oh, he likes stripey shirts (whoa, tiger!) and has been known to use what the trade refers to as male grooming products. (Hey, he's a male. And who doesn't need pampering after that most satisfying of weekend activities, rodding the drains?)

He's just the sort of person, in fact, who would be blown away by PM FutureTech – as were we all. You could tell, by the way that those few delegates who did leave seemed to sidle out almost reluctantly. If you missed FutureTech, you missed out.

But here's the good – no, great – news: get ready to pencil in a date somewhere in the third quarter of next year. It's early days, but don't bet against **FutureTech 2015** happening somewhere near you. Particularly if that somewhere is in Gauteng.

That's a little way up the road, though. What about the here and now?

Well, headlining this month's issue, our colleagues in the USA present their annual celebration of the people and the ideas that made a significant impact on our lives in the past year. The Breakthrough Awards have endured a decade and seem set for a good while longer. Talk about tradition! Potential there for celebrating some homegrown South African breakthroughs, wouldn't you think?

We certainly do. We have made it our business to seek out those local breakthroughs and we will continue to do that. Naturally, we realise that playing in a global arena takes more than a bright idea. On local soil, Sean Woods finds the margin between winners and also-rans in the Sasol Solar Challenge can be expressed in simple, but very ugly, numbers: 1 500 kilometres, 14 years' experience, 7 generations of car... and a budget nearly tenfold that of the last-placed finisher. Yet simple numbers often don't paint the full picture, as we explain in *Chasing the Sun*. It's the kind of thing we do.

So... I grasp the baton. Of course, this being PM, here's what happens next: I bore a few holes in that baton, slap on some circuitry, O-rings and audio hardware, spraypaint it red with black lettering and pronounce it the PM Soundbar. Remember, you read it here first.

[anthony@ramsaymedia.co.za](mailto:anthony@ramsaymedia.co.za)



Page 51





# SEEING ISN'T ALWAYS BELIEVING.

Over time, your eyes may have been known to overlook some of the finer points in life. Fortunately, the right pair of lenses will show you the world in 20/20 perfection, so you're never likely to miss out again. Because the things you trust most never stop working to earn it.

To find out how Coronation can earn your trust, speak to your financial advisor or call us on 0800 22 11 77.

**CORONATION**   
FUND MANAGERS  
**TRUST IS EARNED**

Coronation Asset Management (Pty) Ltd is an authorised financial services provider. Trust is Earned™.



BMW  
ConnectedDrive



[www.bmw.co.za/  
connecteddrive](http://www.bmw.co.za/connecteddrive)

Sheer  
Driving Pleasure





# FREE AS A BIRD.

BMW ConnectedDrive offers a wide range of intelligent Apps and services that provide information and entertainment during your journey. Allowing you the freedom of comfortable navigation on your vehicle's control display using your BMW iDrive system. Wherever you may be.

**#ConnectedDrive**



**BMW ConnectedDrive**  
So connected, you're free.

BMW Apps standard on 5, 6, 7, X5, X6, M3, M4 Series.  
All other models optional except current generation X1 & Z4.



## WARFARE: THAT'S HOW WE ROLL

I refer to recent letters by Neil van der Merwe (Why Armageddon?, July), and TA Ranko (Promote a new world order? Us?, September). The writers' sentiments are touchingly naïve, but please ignore them, for they know not what they speak of.

The history of humanity is the history of warfare. Warfare is undoubtedly our single greatest cause of invention and technological improvement. Weaponry is fundamentally indivisible from humanity. Even our faces are sculpted by the need to handle being hit by other humans. There is not one year of recorded history without a war somewhere on Earth.

In PM July, for example, we saw super-fast helicopters being developed using military funding. Civilian aviation will one day enjoy the spinoff, but thanks only to the military's need for fast helicopters. Companies do not have the time or money to embark on such huge R&D programmes for a limited market. Indeed, the helicopter might still be a curiosity had it not been for the Korean and Vietnam wars.

The airplane developed at a pace unthinkable without war. The cauldron of war moved a wood and fabric device that could barely make 100 metres to pressurised high-altitude bombers that would be the genesis of inter-continental passenger planes in just over 40 years. Incredible!

In fact, do our contributors know they surf the Web (created in the Cold War), and when driving to a friend on a road (developed by the Romans to move troops faster) he is using GPS (a military precision system), launched into space using rockets (developed for long-range bombardment – conventional and nuclear). The list is practically endless when you get into it. Even the steel in our contributors' everyday kitchen utensils was perfected for the purposes of arms and armour and not cooking. Without war, we'd probably be at least 10 000 years behind where we are now, maybe even still in caves. After all, there would have been barely any need to organise societies for defence and build walled cities, develop metallurgy, and roads and so on.

The articles that seem to have raised the ire of the contributors are actually perfectly apt for a publication such as *POPULAR MECHANICS*. In fact, I would raise a complaint that not enough weaponry is featured.

Our contributors should take note of the summary of human interaction provided by the US Supreme Court, paraphrased thus: "People have only two ways of interacting, with reason or with force. If I prevent or discourage your ability to use force, I force you to use reason."

We all want peace. But peace doesn't come by magic; it comes by making others too scared to attack us. Indeed, despite the scale of fighting being greater it is less frequent. Since the advent of firearms the average homicide rate in human societies over the past 500 years has plummeted.

War creates amazing technology. Technology doesn't create war. That's up to us.

CHRIS BENNETT  
JOHANNESBURG

**Write to us, engage us in debate, and you could win a cool prize. This month's best letter wins a Yale Outdoor Hamper valued at R2 750. It consists of a Yale Trailer padlock that's purpose-designed to secure your belongings while you enjoy the outdoors, two Yale all-weather 61 mm close shackle padlocks and two Yale 4-lever lock sets. And, given that these will all be expected to live a hard and useful life in the outdoors, you'll need a little something extra to maintain them: the brand new Un-Jam-It powder lubricant. It's ideal for keeping locks, padlocks, squeaky floorboards, sticky hinges and lots more operating as they should.**

To find out more, contact Yale Security on 011 761 5000, find them on facebook/YaleRSA or visit [www.yalelock.co.za](http://www.yalelock.co.za)

Send your letter to: *Popular Mechanics*, PO Box 180, Howard Place 7450, or e-mail [popularmechanics@ramsaymedia.co.za](mailto:popularmechanics@ramsaymedia.co.za) Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.



## Solving the hidden cities mystery

*POPULAR MECHANICS* has been running a series of articles on deep space and time, involving mathematical theorems so esoteric that they could have been invented by beings from different solar systems.

Space and time are unsolvable mysteries. Much closer to home are mysteries far more in line with PM's engineering DNA. Ancient cities have been discovered deep under the sea, off India and other coastal areas. These have to be thousands of years older than the oldest known cities on dry land, because when the last Ice Age was at its peak about 12 000 years ago, the ocean level was 100 metres lower than now. This means that these cities were built at least that long ago on what were then the continental coastlines.

Discovered after the tragic tsunami of a few years ago, which scoured out huge tracts of sand, the structures under many metres of water off the Indian coast are so obviously man-made that a child could see that: right-angled corners, precise layers of rectangular blocks with precise steps cut in them, all on a huge scale. Marks can be seen on the stones that could have been caused only by humans wielding tools. Yet all this evidence is shrugged off by so-called science as natural formations. It is as laughable as a group of archaeologists digging up the ruins of the Voortrekker monument in five thousand years' time and categorically stating that it was created by rain and wind erosion on granite.

Archaeology has turned its back on this world-changing discovery because it turns their science completely on its head and makes a mockery of all its dogma. They do not want to admit that they have to start all over again. Are they afraid that their lifetime careers have been meaningless? Or are they just afraid of what they might discover if they really started looking into these newly discovered structures?

PM could accomplish a lot by featuring these strange, exciting, very ancient cities and structures. Your engineering-oriented readership would look at them without prejudice, and come to their own conclusions as to whether they were made by Nature, or by Man, at a time when archaeologists insist that humans were running around dressed in skins and living in caves.

Your space-time articles postulate that it is mathematically inevitable that there are millions of planets with life on them, from bacteria to ultra-advanced super-beings capable of generating their own time warps and travelling wherever they please. But I will not scare off your readers by suggesting that some of these myste-



SEIKO KINETIC.  
YOU ARE THE POWER.



NOVAK DJOKOVIC



  
**PROSPEX**  
Kinetic GMT Diver's

**SEIKO**

DEDICATED TO PERFECTION

[info@tregerbrands.co.za](mailto:info@tregerbrands.co.za)



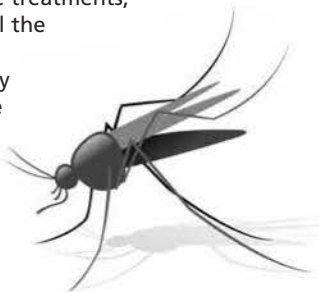
### Mosquito, where is thy sting?

In the aftermath of your nice article about mosquitos I would like to add something – as in the morning after...

Since I was a kid, and as I am a bit allergic, I always had a deep hatred for mosquitoes. These would leave on me, after their meals, some ugly, itchy pimples. As I am in the medical field I tried many after-bite treatments, ranging from cortisone to antihistamine, but still the discomfort would not ease for a long time.

After a trip in Slovenia, where my son was badly stung by a hornet, I was advised to apply a simple cloth soaked in very hot water: it worked! The "venom" is termolabile; it will be inactivated by heat – quickly and forever.

Next step was waiting for a mosquito bite... and the remedy worked. Just hold the hot cloth for a few minutes and you will not feel that itching pain any more.



DR TAZIO TOURNIER  
SEYCHELLES

rious structures may have been built by extraterrestrials that came in on one of your space/time warps.

DAVE SHORT  
HARRISMITH

### Let's encourage amateur stargazers

You often carry articles about space, planets or something else out there. PM October 2014, for instance, featured a series of stunning images involving deep space objects.

I've also noticed that you often offer rather expensive prizes in your competitions, so here is my suggestion: having created an interest in space, why not offer an amateur- to intermediate-level telescope as a prize every now and then? Telescopes aren't as tricky to use as some people seem to imagine. In today's IT-saturated world, the necessary information is only a few clicks away. I imagine the DIY types who read your mag will be just the people to figure out how a telescope works.

As an amateur astronomer and telescope owner myself, I simply see this as an opportunity to give more people a glimpse of what's out there. Even though through a telescope one will never see pictures like those featured in your magazine, one can still aim for targets such as Saturn or the Butterfly Cluster.

WILLIAM ELLERBECK  
BY EMAIL

### Surf's up, mom's online

I loved your article 'Rise of the Silver Surfer' (October). What a great play on words! It reminded me of my mother and how she is one of those people cursed to be a malfunction magnet. It doesn't matter what phone we buy her, she manages to confuse the software to its core so much so that

neither my dad nor her 3 tech-savvy daughters can repair it. We usually resort to a hard reset.

My dad is a Mac-man, so he introduced her to Freehand, much like MS Word. Very user friendly, easy to learn and navigate options... or so we thought. On the umpteenth time she called my dad with her famous "Ag Johan, come help me, this thing is doing funny stuff to me", she managed to turn everything in Freehand orange. No jokes, everything was orange, from the ruler to the options toolbar, the guidelines on the page, even the cursor! My dad had to uninstall and re-install the program after almost an hour of trying to find out what she did, to no avail.

I'm sure if we bought her the prototype watch from Siemens she would still manage to have the OLED refuse to illuminate and have a disco effect with the lights around the house. My dad even recorded a conversation he had with her, trying to convince her to get a new phone. She argued that she was happy to just call and SMS with it. My dad pointed out many things she would find useful, such as a calculator and calendar. She would get angry, my dad would get giggly and we would get good laughs around the dinner table.

ELANA KRUGER  
BY EMAIL

### Put some bite into your Web design

People, please permit me to draw to your attention the dog-food test and explain how your Web site – and just about every single Web site in the world that I've ever accessed – fails it.

Imagine you are a dog-owner. You go into the supermarket, and posted over the pet-requisites aisle you see a sign advertising dog food and proclaiming

"New Improved Taste". How do they know? Who made that determination?

And so it is with Web sites. They seem to be created by geeks hunched over terminals in back rooms. As a consequence, the originator knows exactly what to do in all the circumstances he can envisage, programs for or around them and turns the product loose on the unsuspecting public. But it is not tested and validated by the dogs who have to eat it!

For example, the standard 16-digit credit-card number – on the card itself – is split into 4 groups of 4 numbers, with a blank in between groups. This is because the human brain has considerable difficulty (increasing with age) recognising or remembering long strings of numbers. It's much the same with telephone numbers. This makes the numbers easy to read and to key in when required. But if one keys in *exactly* what appears on the card or in the phone book, the entry is usually rejected as being invalid, not entirely numeric.

Having myself once programmed computers, I know it's dead easy to take whatever is entered, scan it, eliminate anything you don't want (such as blanks or special characters), and then check whatever is left over for validity. If what remains is wrong, then and only then complain. The acid test was always to call in someone who had absolutely no idea of what went on under the covers, and get him or her to carry out the steps required to accomplish a specific task that the program was supposed to handle. If even the slightest hitch or inconvenience occurred, the program failed and had to be corrected before being released.

I recently renewed my PM subscription, and it failed the test. In the block asking for my initials I typed what they are: "C J". And it failed me, even though I didn't put in the full-stops, as convention requires, because it didn't like the perfectly legitimate blank between the letters. So the dog-food test applies there as well.

In general terms, a blank is a perfectly valid character in any numeric, alphabetic or alphanumeric string and can and should be ignored in determining the correctness of the actual data.

CHRIS GRAHAM  
KELLAND, RANDBURG

### We goofed dept

Incorrect page yields were quoted for the Brother MFC-J200 printer featured in Great Stuff, October 2014. The correct figures: high-yield InkBenefit cartridges deliver 2 400 pages in black and 1 300 pages per individual colour cartridge.



Irritation

Razor Bumps

Micro Cuts

NEW



Finally, the end of shaving **irritations**

NEW: The first range by Eucerin® for very sensitive and problematic male skin.

Based on the latest medical skin science:

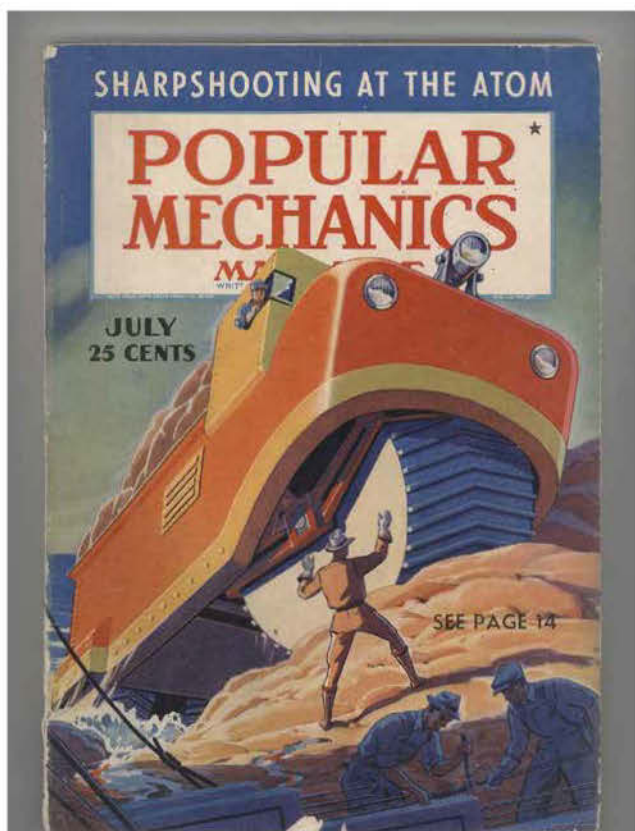
- ▶ Anti-germ silver ions fight shaving irritations
- ▶ Anti-inflammatory Licochalcone visibly reduces irritated skin and razor bumps
- ▶ Clinically proven to soothe and calm irritated skin

Available at selected Clicks, Dis-Chems and pharmacies.  
Consumer Services 0860 102 091

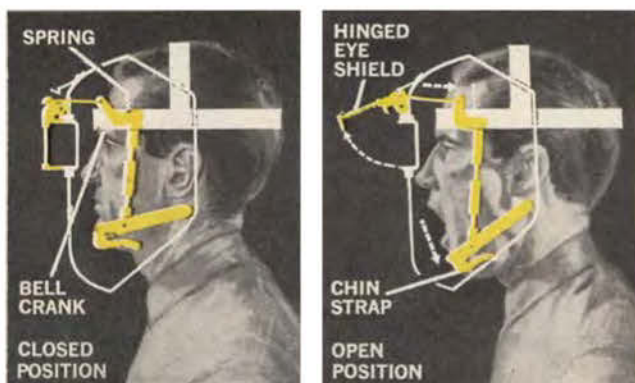
**Eucerin®**

MEDICAL SKIN SCIENCE  
THAT SHOWS

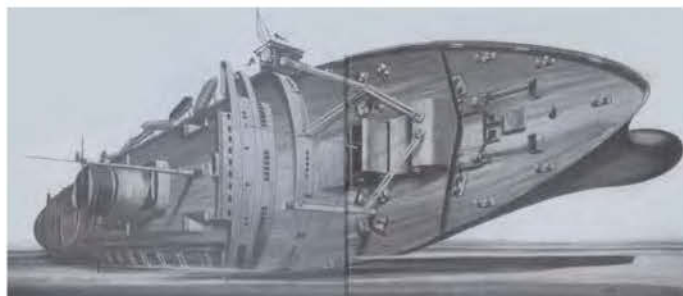




**1940** Could this Canadian invention have been the answer to the state of decay of our less well-kept roads? Designed to travel where no road existed or, for that matter, where no hard surface existed, it also floated. Unlike conventional four-wheeled designs, this unusual beast featured a single front wheel four metres high by two metres wide. At the rear, two smaller wheels swivelled for steering. Each wheel was separately driven by an individual electric motor, powered by a 150-kW diesel.



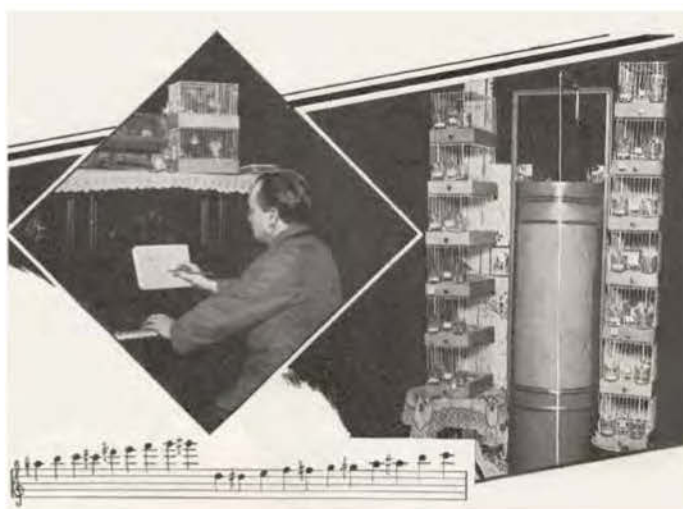
**1968** This chin-operated welding mask obviated the need to stop work periodically and flip up the mask to inspect the weld. Simply pressing the chin down against a strap flipped open a hinged eye shield. A bell-crank arrangement ensured that only a slight chin movement was needed to open and close the window. A slight movement... like a yawn, perhaps?



**1975** While we were paging through the archives, an image of the stricken *Andrea Doria* on its side reminded us of the spell-binding PM FutureTech 2014 presentation by Captain Nick Sloane about the biggest salvage operation in history, the recovery earlier this year of the *Costa Concordia*. The



*Andrea Doria* wreck off the northeast USA coast became a popular dive site, but treacherous conditions – including its depth of more than 50 metres below the surface – have added more than a dozen diver deaths to the original 52 passengers. The ship that collided with the *Andrea Doria* in 1956, the *Stockholm*, was repaired and is reported to still be in operation as the *MV Azores*.



**1935** Gangster movies and TV series have ensured that the expression “singing like a canary” makes us think, not of ornithology, but of a hardboiled type of individual equipped with a Fedora hat, Thompson submachine gun and a Bronx accent. At this Budapest canary school the accent was on the bizarre, though: the feathered coloratura sopranos were made to “bark like dogs, talk and laugh like men, mock screeching cockatoos and warble”. Noted bird psychologist, breeder and song tutor Paul Fodor created a mechanical tutor, consisting mainly of silver piping housing sensitive membranes, to reproduce trills that he notated like conventional music. There must have been a scientific purpose behind all this, but somehow it escapes us.

PM





## \* Good buy or bad location? Context matters.

When investment decisions are made without understanding the complete environment, what seems like a good deal may not be.

Ashburton Investments offers investors exceptional opportunities by providing access to more quality, more insight, more ways to generate returns and more ways to handle risk. From traditional, actively managed funds to alternative investments, we provide new generation solutions designed to deliver access to more. **Find out more at [www.ashburtoninvestments.com](http://www.ashburtoninvestments.com)**

**ASHBURTON**  
INVESTMENTS

*Focused Insight*

A part of the FirstRand Group



# HOW YOUR WORLD WORKS

ASTEROIDS ► IRON DOME ► GENIUSES ► RESTORING ART ► AUDIO ► GREAT UNKNOWNNS

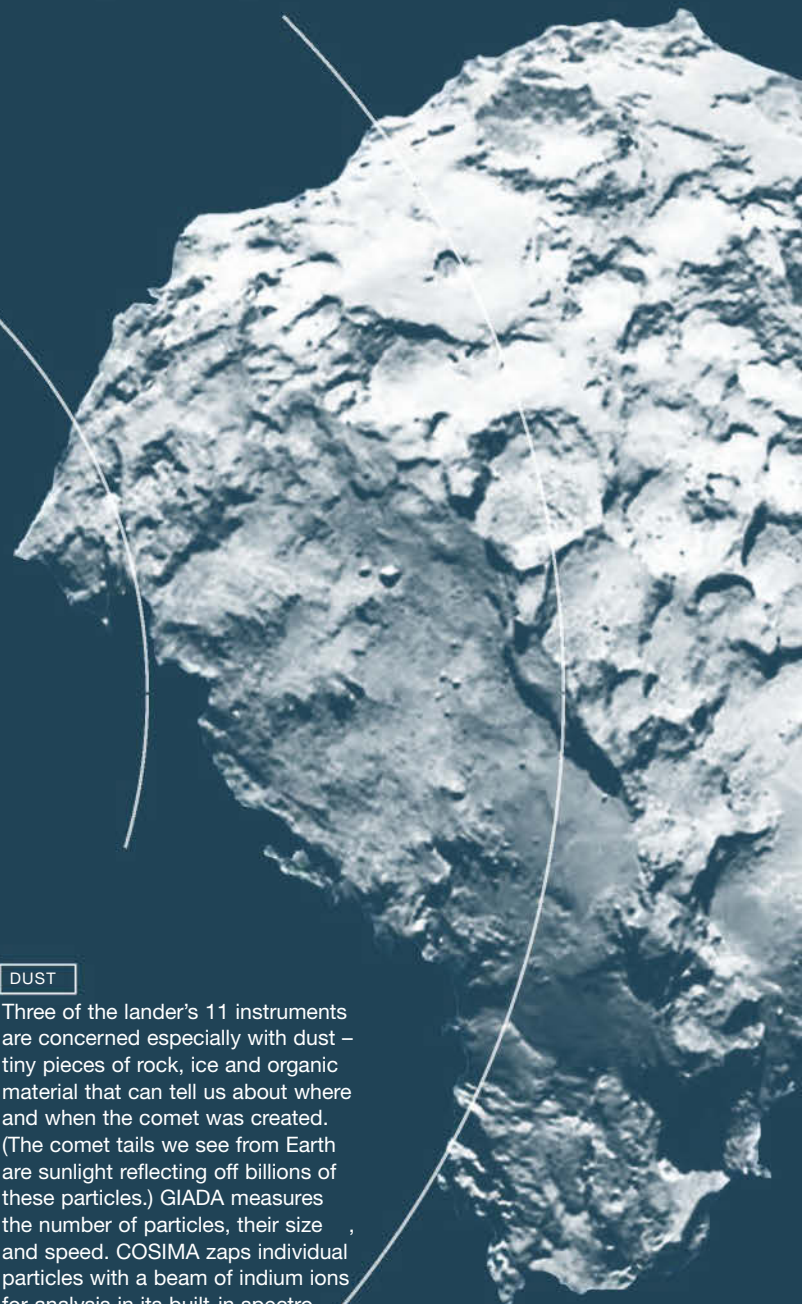
## HOW TO STUDY AN ASTEROID

For the first time ever, man is landing a spacecraft on a comet. Cool. But what do we hope to find?

BY SARAH Z WEXLER



**IT'S A NEW GENERATION'S VERSION** of the Moon landing: if all went as planned, on 11 November, humans would have landed a probe on a comet for the first time in history. Rosetta, a spacecraft sent up by the European Space Agency (ESA) to study the comet 67P/Churyumov-Gerasimenko throughout 2015, pulled up alongside it. Part of Rosetta's mission was to release a craft called Philae, designed to land on 67P and perform scientific measurements that could help teach us about the evolution of our solar system. "Comets are around 4,6 billion years old, primordial debris left over from the formation of the solar system," says Matt Taylor, an ESA project scientist, "so they're little time capsules of the conditions during that time. As we get more data from the comet, we can know how close or far from the Sun it was when it was formed, which helps show us the evolution process." Here is a closer look at the mission details.



### DUST

Three of the lander's 11 instruments are concerned especially with dust – tiny pieces of rock, ice and organic material that can tell us about where and when the comet was created. (The comet tails we see from Earth are sunlight reflecting off billions of these particles.) GIADA measures the number of particles, their size, and speed. COSIMA zaps individual particles with a beam of indium ions for analysis in its built-in spectrometer. And MIDAS can measure particles as small as a few nanometres wide (that's one-billionth of a metre), creating 3D pictures of their size, shape, and structure.

THE WIDTH OF THE 67P COMET IN USS *NIMITZ* AIRCRAFT CARRIERS





#### INTERNAL STRUCTURE

Both Philae and Rosetta have radio transmitters. This allows Philae to send radio waves through the comet to Rosetta on the other side, creating an image like a CAT scan of the comet's nucleus. It could deliver groundbreaking information about a comet's internal structure and composition, and how it evolved.

#### PHILAE LANDER



#### LANDING ZONE

The comet is only 4 kilometres across, is uneven in shape, and has very low gravity. "We need to precisely land something the size of a washing machine on a target that's only a few hundred metres across, in a gravitational pull only 10/100 millionths of what we feel on Earth," says Taylor.

#### THE LANDING

Rosetta drops Philae from 5 kilometres above the comet's surface. This raises the possibility of Philae bouncing off the comet's surface and back into space, where it would be as lost as George Clooney in *Gravity*. To counter this, a jet of cold gas fires at the top of Philae to push downward as it lands.

#### HOW IT HOLDS ON

At impact, ice screws and harpoons secure the lander to the surface. Based on images, "we think it will feel like landing on cork or Styrofoam, with a layer of pumice stone over the top, but truthfully, we don't exactly know", Taylor says. Each of Philae's feet contains piezoelectric transducers (transmitters) and accelerometers (receivers). The transmitter on one foot sends an alternating current, which produces vibrations, and the receiver on another foot acts as a microphone to detect the acoustic waves across the comet's surface, telling us more about its structure and properties.

#### POWER

Philae is powered by a battery that's recharged with energy from six solar panels. To conserve its juice, the tools are made super energy-efficient. For example, the SD2 drill needs only about 10 watts – one-hundredth of what's consumed by the average household drill.

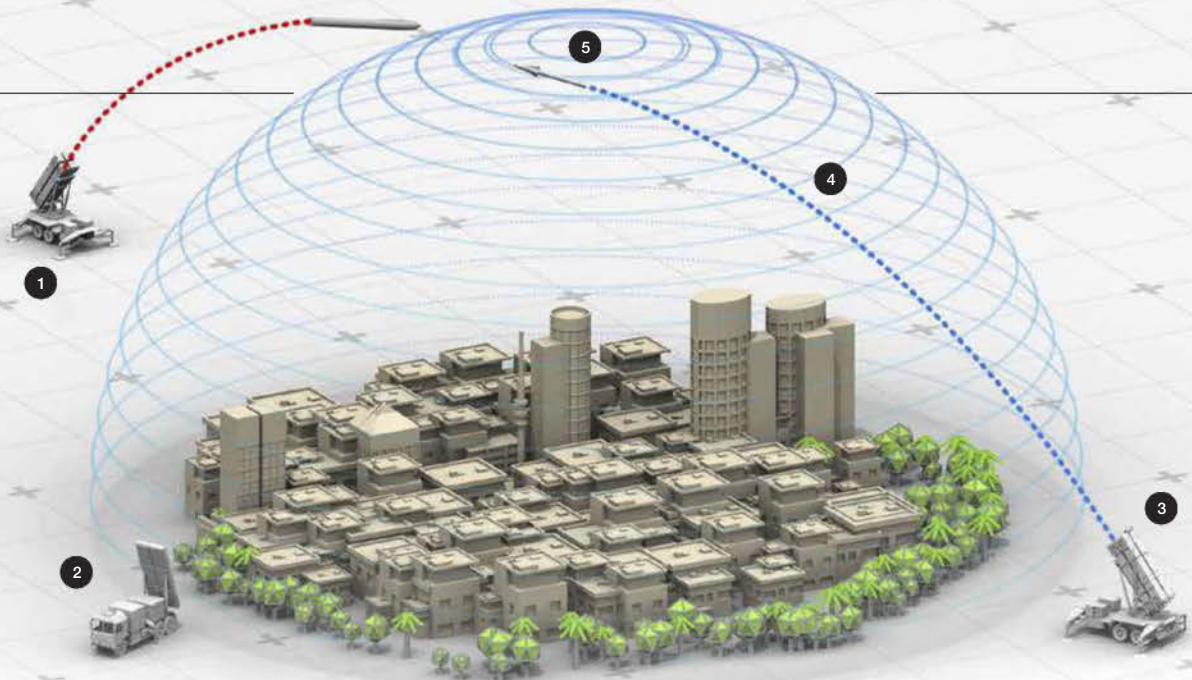
#### REPORTING BACK

Philae transmits data to Rosetta, which relays it to Earth. Since the spacecraft will be 3,4 astronomical units (some 508 million kilometres) from Earth, signals take nearly 30 minutes to arrive.

#### DNA

On previous missions comets have been found to contain glycine, an organic molecule linked to proteins – and thus, DNA – that is considered a building block of life on Earth. Glycines are often released as gas, which Philae locates by "sniffing" the air. The lander also has a tool called SD2 for drilling into the comet and taking a sample. SD2 has 26 ovens (the hottest can hit 800 degrees) to melt the ice and release any frozen gases in samples, allowing researchers to study their density, texture, strength and thermal properties.





## THE MISSILE BUBBLE

How the Iron Dome defends Israel. BY JOE PAPPALARDO

In the first three days of the conflict between Israel and Hamas, more than 300 rockets were fired into Israeli territory from Gaza. Most of them – 90 per cent of those that threatened civilian areas, according to Israel – were intercepted and destroyed by Israel's renowned air-defence system, the Iron Dome.

Shooting missiles to hit missiles is nothing new, but the brains of the Dome are truly unique, allowing the system to automatically identify a never-before-seen missile and shoot it down if it's projected to hit a populated area. The technology keeps Israel a step ahead in what has become an arms race with no end in sight. Last year Iran announced it would produce a two-stage Fajr-5, capable of travelling twice as far as – and much faster than – the original. It's only a matter of time before they appear.

### HOW TO SHOOT DOWN A MISSILE

- ❶ A 6-metre Fajr-5 rocket leaves its launcher, carrying 90 kilograms of high explosive, at a speed of Mach 2.9, or 3 540 km/h.
- ❷ A mobile radar unit detects the rocket and identifies its type. Within seconds a battle management and control (BMC) vehicle has converted the radar information into a trajectory and projected the location of impact.
- ❸ If the missile threatens a populated area, an interceptor is fired.
- ❹ As the interceptor nears its target, the missile receives trajectory updates from the BMC, but it relies on its own on-board radar as it closes in.
- ❺ When the intercepting missile gets close enough, its warhead explodes, showering the target with shrapnel and destroying it. From launch to destruction, the entire process takes less than 5 minutes.



**A MISSILE-DEFENCE  
SYSTEM IN YOUR POCKET**

When a rocket threatens Israel, warning sirens wail and Israeli radio and TV stations interrupt their broadcasts to alert as many residents as possible. But recently another way was devised to broadcast when to seek safety: an app. Red Alert, which reportedly gets its data directly from the Israel Defence Forces, is designed to alert users at the same time the siren does, providing the location and time of the projected strike, so even those who don't hear the siren still get the warning. Trouble is, unlike the sirens, the app notifies people of every missile, not just the ones that threaten their area. Using it is kind of like being in a bar brawl and ducking every time someone else is punched: you get jittery. Your life is constantly interrupted, even when it isn't threatened. Which is not to say that the app is a bad idea – just that it could use geolocation.



HOW YOUR  
WORLD WORKS



A HIERARCHY OF NAMES ASSOCIATED WITH BLACK HOLES  
Hawking, S (see below)  
Einstein, A (see the theory of general relativity)  
McConaughey, M (see *Interstellar*, left)



ALAN  
TURING

BORN 23 June 1912, London / DIED 7 June, 1954



STEPHEN  
HAWKING

BORN 8 January 1942, Oxford

## THE GENIUS FACE OFF

On the occasion of *The Theory of Everything* and *The Imitation Game*, a comparison of two great minds. And movies.

VS

$$dE = \frac{\kappa}{8\pi} dA + \Omega dJ + \Phi dQ$$

21

RANK ON THE BBC'S TOP 100  
GREAT BRITONS

25

$$T_H = \frac{\kappa}{2\pi}$$

Helped crack the encryption of the German Enigma machine, which sent encoded military messages during World War II. Winston Churchill considered Turing's work to be crucial in winning the war.

GREATEST ACCOMPLISHMENT

$$M = \langle Q, \Gamma, b, \Sigma, \delta, q_0, F \rangle$$

He created the Turing test as a means of gauging a computer's intelligence. The test, in which a computer attempts to fool a human into thinking he is talking to a real person, is still a benchmark for artificial intelligence.

GREATEST ACCOMPLISHMENT  
THAT'S NAMED AFTER HIM

He suggested putting participants in the Turing test in a telepathy-proof room in order to avoid the challenges posed by administering the test to those with ESP.

MOST QUESTIONABLE THEORY

In *The Imitation Game*, Benedict Cumberbatch plays Turing as a fun-to-watch, somewhat endearing autistic genius wholly focused on cracking Enigma. His inability to function socially leads to some fun, subtle jokes – and makes you wonder about the editorial freedom it took to eventually make Turing a sympathetic character. Not that it matters. Even if no one could stand his company, we can all appreciate his work.



NEWEST MOVIE ABOUT HIM

$$S_{\text{BH}} = \frac{kA}{4\ell_p^2}$$

Explained black holes and the beginning of the universe in language we can almost understand in *A Brief History of Time*. The book stayed on the New York Times bestseller list for 147 weeks.

In 1974 he came up with the theory of black hole radiation, now called Hawking radiation, which is emitted from black holes and can lead to their eventual explosion.

In the 1980s Hawking proposed that, at the end of the universe, as it collapses into itself, time would run backwards. He has since withdrawn the claim.



*The Theory of Everything* is not a sappy love story. Yes, there is a bit of that – the sweet interaction of a couple infatuated with each other, even if one of them needs to be untangled from sweaters he can no longer put on himself. But what you really get is a sense of a man everyone knows of but few of us know much about. Eddie Redmayne has as good a chance at an Oscar as Hawking does at being smarter than you.



# SCIENCE SAVES ART

A new restoration method makes five damaged Mark Rothko paintings look fresh – without a single brushstroke. BY JOE BARGMANN

**YOU HEAR HARVARD UNIVERSITY AND THINK:** smart people there. They ought to know how to preserve great art. So it was baffling and a little tragic when, in the 1960s and '70s, the university allowed the irreversible damage of five murals by the American Abstract Expressionist painter Mark Rothko. Commissioned in 1962 and hung in a student-centre dining room, the paintings were faded by sunlight, dinged by furniture, and even marred by graffiti. Finally, under a cloud of shame, Harvard placed the canvases in storage in late 1979. No one knew at the time that a Rothko would someday sell for \$87 million (about R980 million), as one did in 2012. But still. The negligence was a travesty.

On 16 November the murals will go back on display at the Harvard Art Museums, in Cambridge, Massachusetts. They will look as if they were freshly painted, but that will be an illusion, because the original colours will appear via light beamed on to the surfaces from ceiling-mounted projectors.

Traditional restoration includes removing surface dirt and varnish, which turns yellow over time, and inpainting, or directly applying paint to bring back faded colour and fill in areas where the original material has cracked and fallen away. But it's impossible to revive a Rothko by these methods. For one thing, his paintings don't have a protective varnish, and no ethical conservator would alter a work in a way that could not be reversed.

Plus, Rothko made his own paint (and closely guarded the formula) using animal glue, synthetic resins, eggs, and powdered pigments. The unique recipe gave him one of his desired effects: saturation to the point that the colour actually penetrated the canvas, creating visual depth.

The current restoration effort effectively began with Kodak Ektachrome colour transparencies of the murals, taken in 1964. The transparencies themselves were



The restored *Panel One*. Rothko's son, Christopher, says the restorations "feel like real objects, not something that has been 'painted over' with light. You can see the brushstrokes".

faded, so conservation scientists from Harvard worked with experts from the University of Basel to digitally restore the original colours. Rothko's son, Christopher, then provided the crucial piece of reference: a sixth

mural that his father had painted for the installation, but stashed away. "It had seen the light of day for only a couple of hours," he says. "They had the original colours and could know with quite some certainty that they were accurate."

Using the Ektachromes and the sixth mural as references, MIT's Ramesh Raskar, a pioneer in computational photography, coded an algorithm that allowed him to fine-tune the colour, pixel by pixel, so that the projections compensated for fading and damage rather than simply covering it up. The painting and the light work in concert to create the image of the mural as new.

Christopher Rothko wonders whether the restoration method might draw criticism as painting by numbers, albeit with light. "There's tremendous potential for something good to come out of this, but also tremendous potential for controversy," he says. "This is the bioethics piece of the art conservation world. I'm interested to see how it plays out. My father's work is kind of the guinea pig for this process. I hope it's not something that is just looked at and put away in a closet." Again.



*Panel One's* original installation, January 1963.

## ROTHKO'S PAINT RECIPE



POWDERED  
PIGMENT



EGGS



ANIMAL GLUE



SYNTHETIC  
RESINS



HOW YOUR  
WORLD WORKS

Everything you listen to music on has an amp. Your stereo, your computer, your phone. It's how sound gets pushed out to your ears. But most of the amps in those devices are tiny. Crank the volume over halfway and you start to get distortion. So: if you like music, you want a bigger amp. Not in your already cramped computer. You want it in your headphones.

For the first time in its history, Blue Microphones – the guys who make mics used by everyone from Jay-Z to Springsteen – has come out with a pair of headphones, the Mo-Fi. Mo-Fi has a dedicated amp that takes the burden off your phone or computer. That way, the device's amp runs at its ideal (that is, low) volume setting, and Mo-Fi's amp fills out the sound with classic analogue technology – no digital tricks or bass boost. In our tests, a movie on a MacBook Pro sounded rich and booming, and the New Pornographers' new album had a range and clarity (and tam-bourine intensity) that felt like we were sitting in the studio. The amp is powered, so you have to charge the headphones to use them, but an automatic shutoff switch is activated every time you take the Mo-Fi off. If the battery does die, Mo-Fi still works, but as standard, passive headphones. Probably just to remind you of what you're not missing.

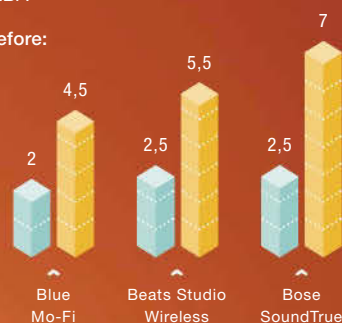
## HEADPHONES THAT CAN FIX YOUR MUSIC

Unless you're listening to Maroon 5. Then you're on your own. BY PETER MARTIN

### THE ONE-WOMAN WEAR TEST: HEADPHONES BY DAVEY ALBA

Hours worn before:

ear sweat  
head pain



The Mo-Fi's hinge design is based on the suspension of a Formula One race car.

Foam ear cups are actually shaped like ears and can extend to rest more comfortably around your neck when you're not using them.



## MAKING A GOOD BEER BETTER

Now if only you could find some.

BY ANDREW DEL-COLLE

This past April John and Jen Kimmich, the husband and wife duo behind the wildly successful US brewery The Alchemist, in the northeastern state of Vermont, got excellent news: something was wrong with their canning line. The Kimmiches make a double India pale ale called Heady Topper – considered one of the best beers in the world. It sells out in less than a day and is so popular that the brewery had to stop tours and retail sales to appease the neighbours. But John still wasn't happy with it. He wanted to find out how the scant amount of dissolved oxygen, which can break down the hops and slowly erode Heady's complex flavour, was getting into the beer. He finally had his answer: the canning process.

"That was just fantastic," he says, "because we knew it wasn't us. It was the machine. It was something that could be fixed."

Cans are important at The Alchemist. Because Heady is an unfiltered beer, it remains alive and especially volatile after packaging. Cans protect the beer from sunlight, which can wreak havoc on Heady's fragile hop oils. The narrow opening concentrates the beer's intense aroma on every sip. This is why the top of each Heady has an impossible-to-miss command in capital letters: drink from the can.

A few tweaks to the process – filling each can faster creates extra foam that keeps air at bay while the top is secured – and now you get the full flavour of Heady for months: an effervescent mix of citrus and pine made from special hybrid hop strains sourced from the US Pacific Northwest, added late in the brewing process (they use CO<sub>2</sub> hop extract for bitterness).

Too bad the beer is almost impossible to get, even on home soil. High praise and scarcity have elevated it to mythical status. The brewery maxes out production at 9 000 barrels a year and only sells locally. The Kimmiches plan to open a new brewery by next summer, but they won't be expanding Heady production. They will, however, brew three new beers.



## Redefining Excellence



YOU, PLUS THE WORLD AROUND YOU  
8MP BSI front camera with panoramic selfie



## HUAWEI *Ascend* P7 Excellence With Edge

### Redefining Craftsmanship

Sleek glass back with 7-layer metallic feel treatment  
6.5mm slim body with ultra fast LTE connectivity

### Redefining Camera Experience

Powerful 8MP BSI front camera with panoramic selfie  
13MP rear camera with ISP powered low-light shooting

### Redefining Connectivity

2500mAh high density battery with ultra power saving mode  
Innovative dual antenna design with smart network switch

Call Centre Number: 0860 86 11 11



[www.facebook.com/huaweiDeviceSouthAfrica](http://www.facebook.com/huaweiDeviceSouthAfrica)

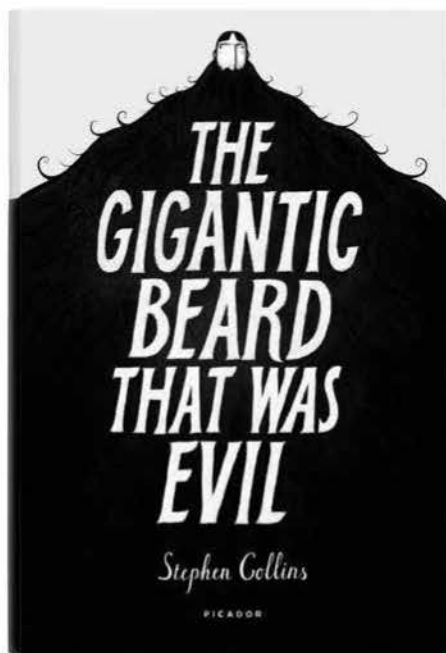


[#whaway](https://twitter.com/HuaweiZA)

<http://consumer.huawei.com/za/>



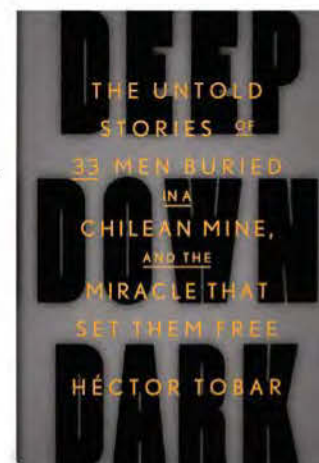
## FEAR AND FEARMONGERING



### THE GIGANTIC BEARD THAT WAS EVIL, by Stephen Collins

The debut graphic novel by *Guardian* cartoonist Stephen Collins is drawn entirely in soft pencil – a monochromatic narrative and a sublime fable about what it means to be different. At the centre of the story is Dave, a man of order and routine. Dave lives in a Truman Show-like community that values tidiness and robotic predictability. And he fits right in, until one stubborn whisker morphs into a beard of inexplicably gigantic proportions. His follicular flood disrupts the comfortable monotony of his fellow townspeople's lives, turning them all into fearmongers. The story may not make you want to grow a beard – and certainly not one that has to be trimmed with a scissor-wielding tank – but it will make you take pause before judging the people around you. Especially when it comes to facial hair, because that can really grow on a person.

– THERESA BREEN



### THIS MONTH IN NON-FICTION: The Untold Stories of 33 Men Buried in a Chilean Mine, and the Miracle That Set Them Free, by Héctor Tobar

Pulitzer Prize winner Héctor Tobar reveals, in suffocating detail, what happened 700 metres beneath the surface of the Earth during the Chilean miners' 69-day entombment. The narrative details how the workers survived the mine's seemingly catastrophic collapse – and later how they bore up under the weight of their surreal post-rescue celebrity. Not for the claustrophobic.

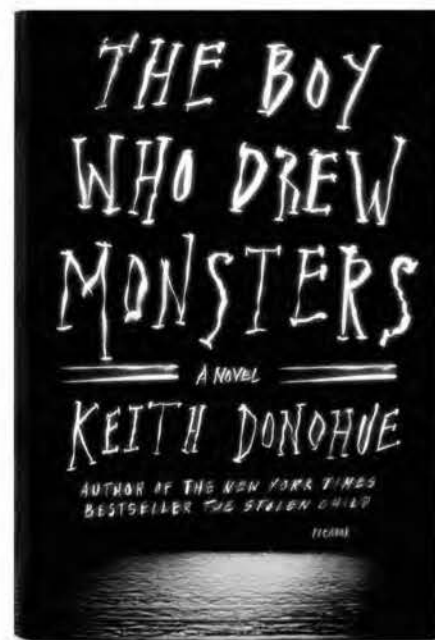
### THE BOY WHO DREW MONSTERS, by Keith Donohue

Three years after Jack Peter Keenan, the 10-year-old referenced in the title of Keith Donohue's engrossing new novel, almost drowns off the Northeastern US coast, he develops a near-crippling fear of leaving his house. Narratively speaking, this is a risky wager. Donohue has essentially put his characters – and thus his readers – under house arrest, and yet the bet pays off again and again. The novel is a pressure cooker, an airtight room with limited oxygen, and an astute study of the mysterious demons that loss breeds.

There also may be real demons in *The Boy Who Drew Monsters*, and, to the author's credit, that possibility is altogether more menacing than any concrete knowledge would be. Donohue suspends the characters – especially Jack Peter's parents – in a state of growing paranoia. Holly, the boy's mother, loses sleep to a host of phantom sounds that she alone hears. Henry, his father, is besieged by visions of a pale figure stealing into the dunes, and he spends his days and nights increasingly convinced that if he could just lay hands on the thing – whether human, animal, or apparition – he could rid his son of his phobia and free the family from the shackles of his fear. Through it all, Jack Peter draws monster after revelatory monster. The phantom noises grow louder, and the pale vision stalks closer, and the question of whether these terrors are real or rendered takes on a thrilling life of its own.

The book's final twist – and by final I mean, like, in the very last sentence – is satisfying in a *Sixth Sense* kind of way, but the manner in which Donohue keeps us in the dark until then is the novel's real reward. Closing the book, when you can see all of the monsters for who they really are, you may feel a little tricked. It's understandable, maybe inevitable. But you'll also make a point of locking the front door, and you'll think twice before stepping outside again.

– BRET ANTHONY JOHNSTON







*LOOKS LIKE AN SUV. HANDLES  
LIKE A SPORTS CAR.*

zoom-zoom  
zoom-zoom



21600/MAZDA CX-5 BLACK RIVER FC

The all-new Mazda CX-5 creates perfect harmony between form and function. Inspired by the predatory stance of a cheetah stalking its prey, the CX-5's KODO, "Soul of Motion" design shifts weight to the rear for greater stability and even more power. On top of that, the commanding SKYACTIV 2.5 Petrol engine produces a muscular 250 Nm of torque, 138 kW of power and a fuel consumption of just 6.9\* litres per 100 km. The CX-5 is not just an SUV. It's a new breed of vehicle.

\*Under Mazda test conditions.

3

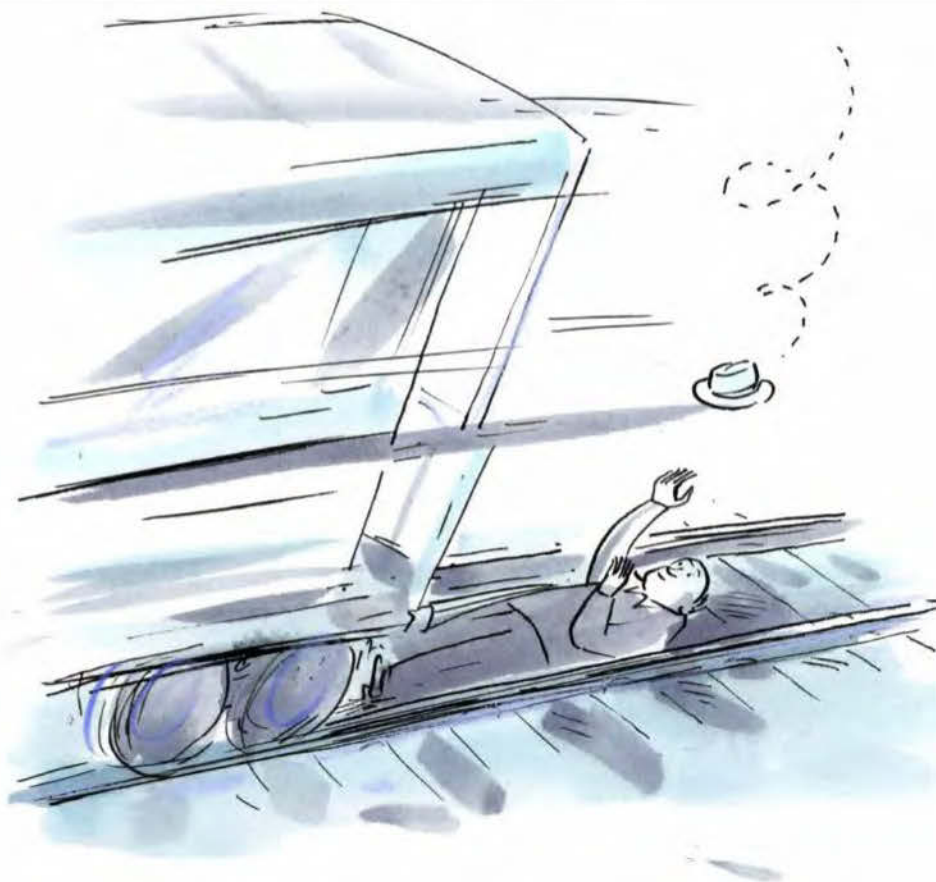
YEAR  
UNLIMITED  
KILOMETRE  
WARRANTY

*THE ALL-NEW MAZDA CX-5.  
THE IMPOSSIBLE MADE POSSIBLE.*

Visit us at MazdaSA on  @Mazda\_SA on  or [mazda.co.za](http://mazda.co.za)



Do you have unusual questions about the world and how it works and why stuff happens? This is the place to ask them. Don't be afraid. Nobody will laugh at you here. Email [popularmechanics@ramsaymedia.co.za](mailto:popularmechanics@ramsaymedia.co.za). Questions will be selected based on quality or at our whim.



## TRAIN TRACKS, RECYCLING AND ARMED INSURGENTS

**Are trains designed such that if a person were about to get run over, he could lie flat between the tracks and avoid death as the train passed over him?**

In much the same way that every chandelier is deliberately engineered to support the weight of an adult male swinging from it by one hand while firing an automatic weapon with the other. Which is to say: only in the movies.

Although you could get away with the lie-flat-between-the-tracks gambit (and people have), it's far from a sure thing. Train carriages conform to certain mandatory design parameters, but these are aimed at ensuring that they can fit through tunnels and pass trains on adjacent tracks without unpleasantness, not at providing you an easy out for avoiding catastrophe. Perhaps the one marginally relevant specification is that a train car's axles must clear the top of the rails by a specific distance (at least 7 cm in the USA). If the distance between the tops of the rails and the track bed beneath were great enough (and you were compact enough), you might one day regale barroom audiences with tales of the time you got run over by a train and lived.

Or you might not. It isn't unusual for parts, equipment, objects, etc, to protrude below the rails or to come loose and drag beneath the train. And if we're talking about under-

ground railways, you also have an electrified third rail to avoid, lest you be tased straight to Heaven Junction. Train ducking may be worth a shot in an absolute, no-other-options emergency, but beyond that it's perhaps best to stick to the safer stuff, like jumping off fire escapes into dumpsters loaded with shock-absorbent garbage. (Just kidding, don't do this.)

**How do insurgent groups like ISIS get their weapons? Are they US-made?**

The unfortunate fact is that the world is awash in armaments, and, yes, many of them are (or were) American.

Leaving aside homemade weapons, insurgents looking to arm themselves may turn to state sponsors or, failing that, to a richly stocked global black market, assuming they have money. Particularly in Africa and the Middle East, government-arms stockpiles may not be well guarded or monitored, allowing weapons to filter out into the hands of unscrupulous dealers and from there into the clutches of pretty much anybody with a buck. The United Nations has identified Libya, for instance, as a key origination point for illicit arms.

Once an insurgent group is operational, it can often seize additional weapons, as ISIS has in Iraq, a country flooded with implements of war, including many of American origin that were provided to the Iraqi Government or left behind when US troops pulled out. Booty captured so far by ISIS includes US artillery pieces and Humvees, a state of affairs that has resulted, paradoxically, in American air-strikes on American weapons. **PM**



# Say hello to the Altech Node.

Your complete entertainment and  
smart home experience.

With over 700 hours of movies, series and sports content as well as  
home control of surveillance and electrical devices; it's the little box  
that does a lot of stuff.



One day we'll wonder what we ever did without it.

Available at the following stores:

Altech Autopage Cellular, Cell C, Dion Wired, Game, HiFi Corporation, Hirsch's, Incredible Connection,  
JetMart, Makro, Pick 'n Pay Hyper and other leading retailers.

# PM TESTED

## JUD500 Ultrastation

### Broaden your options

**The plunge** in the demand for desktop computers and the commensurate rise of mobile devices has its pros and cons. Yes, portability is a strong point of mobile devices such as tablets, notebooks and netbooks, particularly thanks to rapid, vast increases in processor power. But the much smaller footprint of those portable devices means they often have to do without some things those of us accustomed to desktops have taken for granted: connectivity options that don't involve wireless, for instance. Multiple USB ports and a display port, to be specific. With some devices they simply aren't possible, unless you have a fistful of adaptors.

That's where the JUD500

Ultrastation comes in. An update on the original introduced about two years ago, this latest version now features two USB 3.0 ports (one with battery charge facility) and a single USB 2.0. In addition to that there are connectors for video, Ethernet and audio. Of course, this presupposes that your device has at least one compatible USB port to connect to in the first place.

So far, we'll admit, it sounds like just another hub. What sets the Ultrastation apart is the Wormhole switch. It allows you to drag and drop or copy and paste to another Windows or Mac computer via a USB connection. And that's between similar, or different, operating systems. Similarly, it allows

keyboard and mouse sharing across multiple platforms.

Initial setting up was fairly straightforward. Although we had mislaid our Macbook's portable DVD drive, downloading the device drivers from <http://lj5create.com/support.html#jud500> went without a hitch. Installation was equally straightforward and within a few minutes we were up and running. There was a minor issue with trying to ensure the cursor was visible in MS Word (in other words, with the wireless mouse interactivity), but that resolved itself swiftly.

Physically, the Ultrastation's oval form factor allows it to sit unobtrusively behind the average notebook. It can also

snuggle up really close, thanks to grippy rubber rings that both keep it from slipping and act as bumpers.

The Ultrastation is compatible with Windows and Mac.

### SPECIFICATIONS

#### REQUIREMENTS:

Windows 8/7/XP (32/64-bit);  
Mac OS X v10.6, 10.7, 10.8;  
USB port (3.0 recommended)

#### CONNECTIVITY:

USB 2.0  
USB 3.0 (x2)  
VGA  
HDMI (up to 2048 x 1152)  
Ethernet 10/100  
Mic in  
Speaker out

#### DATA TRANSFER:

Wormhole: up to 480 Mbps

**PRICE:** R1 295





## Carmate Pro

### Go on, do the right thing

There really is no good reason to find yourself being pulled over by a police officer for using your cellphone while driving. Apart from being plain dangerous all round, it's also unnecessary when every hole-in-the-wall cellphone and audio accessory outlet can provide you with a cheap hands-free kit, such as the CarmatePro.

Neatly packaged into one combination unit, CarmatePro provides Bluetooth functionality with some add-ons that propel it into some pretty high-powered company. It is described as a universal 4-in-1 unit, with the ability to integrate your music, a role as a hands-free kit, a universal phone charger and hands-free phone holder.

Hands-free telephony is carried out by means of a built-in microphone and the car's sound system. Bluetooth connects the device to your phone; it taps into the sound system by transmitting an FM signal. Reception and sound quality were quite acceptable. It's also possible, by means of an app, to use voice recognition to make hands-free calls. Incidentally, when a call comes in, or your smartphone sat-nav issues an instruction, the device automatically mutes.

The CarmatePro is powered by your car's 12 V socket and, thanks to the bendable, semi-rigid connector between adaptor and controller, can be positioned where it's handiest. The connector itself feels quite rugged, but given the bouncy life the assembly is bound to lead, there could be some strain on the 12 V connector. The plastic used in construction of the controller is also fairly lightweight. The smartphone bracket that clips into a handy airvent (supplied as part of the kit) feels tough enough, but also perhaps isn't a permanent solution. The cradle does fit a reasonable range of devices, though (up to 90 mm) and is rotatable. One big plus compared with windscreen-mounted brackets is that it's closer to reach.

### IN THE PACKAGE

Combination Bluetooth control unit/transceiver/12V adaptor  
Smartphone bracket  
USB to micro-USB charging lead  
3,5 mm Aux lead  
Price: R599





## Logitech z333 Multimedia system

### Sound investment

**One of the ubiquitous** sub-and-satellite 2.1 sound systems that seem to have become the norm for PC sound, the Logitech provides a fuss-free, discreet option. It could even do duty as a main home system where you don't have lots of space, with a wide range of compatibility from computers to smartphones, DVD players and game consoles.

Firstly, it's relatively easy to set up. The colour-coded speaker leads are a good idea in principle, but can be initially confusing because they are terminated in RCA sockets, which is more commonly used for inputs, not for outputs. In fact, a pair of RCA inputs is situated directly above the outputs.

Compared with our (significantly more expensive) in-office set-up of 10 watt-per-channel valve integrated amp with miniature vintage full-range sealed-box speakers, the Logitech definitely offers a more substantial bass that added a degree of greater realism and weight. However, our office system provided more apparent clarity and created a sense of spaciousness and ambience, though clearly emphasising the upper midrange to create a "cupped

hands" sound that affected vocals particularly. The Logitechs sounded more close-up, with a thicker sound to the midrange and surprisingly less apparent clarity at the upper end. Where the Logitech system scores significantly is in its greater sense of power. There was clearly plenty in reserve – it's rated at 40 watts RMS.

Ergonomics are good. The on/off switch and volume adjustment is located on a handy satellite rotary control, so once it's set up, you shouldn't have to fiddle with controls and connectors on a subwoofer under a desk or on one of the satellites. There's also a standard 3,5 mm stereo headphone socket.

The satellite speakers, with 75-mm drivers, are a little more solid-feeling than the typical PC add-on units. Little rubber nubs underneath act as feet and help stop the enclosures from being moved around accidentally.

At the rear of the subwoofer enclosure is a rotary control for bass. It seems to have most effect from about halfway. In practice, at normal listening levels we preferred to use it with the knob set to the mid-position.

### THE DETAILS

|                     |         |
|---------------------|---------|
| <b>Total output</b> | 40 W    |
| <b>Subwoofer</b>    | 24 W    |
| <b>Satellites</b>   | 2 x 8 W |
| <b>Subwoofer</b>    | 125 mm  |
| <b>Price</b>        | R2 000  |





# LOOKING FOR GIFT IDEAS?

**TWO AMAZING BRANDS, ONE BOX**



**LEATHERMAN®**

**LED LENSER®**



**REBAR®**

**17**



- 1 Needlenose Pliers
- 2 Regular Pliers
- 3 154CM Replaceable Wire Cutters
- 4 154CM Replaceable Hard-wire Cutters
- 5 Ruler
- 6 420HC Knife
- 7 Saw
- 8 Wood/ Diamond-coated Metal File
- 9 420HC Serrated Knife
- 10 Small Screwdriver
- 11 Phillips Screwdriver
- 12 Awl w/Thread Loop
- 13 Bottle Opener
- 14 Large Screwdriver
- 15 Can Opener
- 16 Wire Stripper
- 17 Lanyard Ring



**P7.2**

| P7.2          | Boost         | High    | Low    |
|---------------|---------------|---------|--------|
| Luminous Flux | 320 lm*       | 250 lm* | 40 lm* |
| Burning Life  | 2 h**         | 4 h**   | 50 h** |
| Beam Distance | 260 m*        | 220 m*  | 100 m* |
| Batteries     | 4 x AAA 1.5 V |         |        |

\* Luminous flux (lumens) and max beam distance (meters) are measured when switching on with a new set of fresh batteries. \*\* Average hours of burning life as measured in the least energy-consuming mode and until residual luminous flux amounts to 1 lumen.

**NITE IZE®**

**PICQUIC®** SINCE 1988



## STEELE CAR MOUNT KIT



The Steelie Car Mount Kit is the perfect phone holder for your car. It docks your phone to your dashboard in a snap, so it's visible, accessible, and right where you need it, everywhere you go.

## STEELE PEDESTAL KIT

Whether you're typing, viewing, reading, or video chatting, the Steelie Pedestal Kit is a smart, stylish way to keep your tablet securely upright and conveniently accessible. When the attraction is this magnetic, things just click.



**Teeny Turner™**  
Turning Teeny Screws



The Teeny is perfect for servicing eyeglasses & today's electronic devices. It is available in a range of bright, fun colours and is fast becoming the most sought-after Picquic.



**SIXPAC Plus™**

The original Picquic is full size for professional or at home use. It features a solid handle for maximum comfort and torque and no moving parts to break (or lose). Bits are ideal for use in drills and power-drivers.



Available at all leading outdoor stores & selected independent stores | Awesome Tools are the exclusive distributors of these brands in South Africa.

E & OE

Tel: +27 21 981 6672 | [www.awesometools.co.za](http://www.awesometools.co.za)



### THE DETAILS

|                     |                                                                                                            |
|---------------------|------------------------------------------------------------------------------------------------------------|
| <b>Battery life</b> | up to 8 hours using GPS and HRM                                                                            |
| <b>Display</b>      | 22 x 25 mm                                                                                                 |
| <b>Thickness</b>    | 13,8 mm                                                                                                    |
| <b>Weight</b>       | 63 g                                                                                                       |
| <b>Sensors</b>      | motion, compass, optical heart rate, Bluetooth                                                             |
| <b>Price</b>        | R3 799; Multi-Sport Cardio R4 599; Multi-Sport Cardio Bundle (includes altimeter, cadence and HRM) R5 599. |

## TomTom Runner Cardio

### Heart on my sleeve

**Clunky fitwatches** of just a few years ago have given way to sleek, stylish designs that provide cutting-edge performance with practicality. Part of that revolution has been driven by the fitband boom and part of it by the need for devices that don't scream "geek alert!". Today's fitwatches can, in fact, be worn all day long.

TomTom's Runner Cardio, like some fitbands, consists of a pod that slots into a housing in a wrist strap. But the TomTom goes one better. Unlike the conventional setup of fitwatch plus heart-rate belt, it incorporates its heart rate monitor sensors into the device itself. It accomplishes that neat trick by means of optical heart rate monitoring. That's right, it actually looks into the wrist's blood vessels to monitor your pulse, using Mio sensor technology. The whole thing is pleasingly quick and accurate, certainly compared with the fiddly belts, which require very good electrical contact – which can mean slath-

ering on specialist gels or, in a pinch, spit or sweat.

Compared with a Garmin GPS sports-watch that uses the chest belt system, the TomTom scores highly on ease of use and actual data acquisition. In terms of immediate data available on the go, the Garmin's customisable screens that can be set to scroll at variable speed were marginally preferred to the TomTom's menu-driven system. That said, it's not hard to get acclimatised to the TomTom's method of operation, which uses a cursor/joystick control on the wristband. Toggling through the modes becomes second nature after a while and, in any case, there is only so much data your brain can absorb while working out. Perhaps recognising that, instead of displaying the distance or time elapsed as a number, the Runner shows it as a kind of pie chart.

Besides the joystick, the display itself is a control surface. Tapping it turns on the

backlight, signals a lap, or indicates Pause or Stop.

The biking and swimming modes of the MultiSport version (another plus: it's waterproof to 50 metres) seem to have potential, too.

Cons? We reckon that the TomTom Mysports web site could do with some tweaking when compared with some of its rivals. Against that the TomTom's smartphone connectivity facility is a distinct plus, as is its multi-platform ability. Overall, this will matter less to users who are more focused on the TomTom device's convenience. It wasn't always easy to positively clip the unit into its charging cradle, but again that could also just be a matter of familiarity.

There are established high-end models that offer more features and a more polished feel, but the TomTom is pitched at the mid-range, where the bulk of the action happens. There, we reckon, it is a convincing option.

PM



# THE ALL NEW **TSW R-SERIES**

PAST, PRESENT, FUTURE



**EVO-R**  
15"/17"  
4/5 STUD FITMENT

**IMOLA-R**  
15"/17"  
4/5 STUD FITMENT

**HOCKENHEIM-R**  
15"/17"  
4/5 STUD FITMENT



Pimp your wheels with different coloured nuts, including: chrome, red, blue or black.

**TSW R-SERIES COMING SOON**  
**SEE [WWW.TWT.TO](http://WWW.TWT.TO) FOR DETAILS**

**Tiger**  
wheel&Tyre





**VICTORINOX**  
SWISS ARMY

COMPANION FOR LIFE



**I·N·O·X**  
[FORGED TO RESIST]

TEST N° 86/130  
NITRIC AND SULFURIC  
ACID SOLUTION RESISTANCE

 **130**  
years

For further information contact Picot & Moss 011.669.0500. [www.picotandmoss.co.za](http://www.picotandmoss.co.za)

MAKERS OF THE ORIGINAL SWISS ARMY KNIFE | [WWW.VICTORINOX.COM](http://WWW.VICTORINOX.COM)



For the 10th year in a row, we honour the innovators, engineers and scientists most responsible for changing our world.

SPECIAL DECENNIAL EDITION!

# THE BREAK- THROUGH AWARDS

**EVERY YEAR IT HAPPENS.** Brilliant people – inventors, scientists, high school kids – keep coming up with ideas that not only make us think, they make us hope. In the past decade we've covered retinal implants that restore sight to the blind, a mind-controlled robotic arm, a giant plastic wheel that can clean up an oil spill, lasers that kill cancer, and a 3D-printed splint that saved the life of a 6-week-old baby with a collapsed trachea. • This year is no different: 2014 has seen the creation of a car built from only 64 (3D-printed) parts, a premade skyscraper, and a new gear kit that drastically reduces the weight US Marines must carry in combat, potentially saving lives. There's even a guy at Facebook who's deliberately manipulating us – and to whom, when you really think about it, we owe a little gratitude. • While it's true that lately the world has tended to feel as if it's falling apart, it's comforting to know that there are people, great people, here to put it back together. Or to arrange even better things from the pieces.

# THE COMEBACK

Crippling pain derailed Molly McCarthy's body, life, and future. A device implanted in her spine restored it all.

By JENEEN INTERLANDI  
PHOTOGRAPHS by VICTORIA WILL

# O

ON A WARM AUGUST AFTERNOON, Molly

McCarthy is hustling along 76th Street on Manhattan's Upper East Side. She has just 40 minutes to squeeze in a training session before she's due back at the office where she works as an advertising executive. She crosses Second Avenue, ducks into the New York Sports Club, and dashes to the locker room, where she changes, wraps her wrists with pink tape, and grabs a pair of pink boxing gloves from her locker.

In the gym she slides through a series of exercises using a kettlebell and a TRX bar, looking every bit the natural-born athlete who, back in her hometown of Danbury, Connecticut, was one of two 8th graders in her class to make her high school's senior hockey team. She powers through a set of one-legged push-ups before finishing her workout by walloping a heavy bag with the gloves. Her heart rate rockets and her limbs flood with lactic acid. She sweats copiously. The pain feels good.

She smiles widely and easily after each phase of her routine. At the end she pulls out a small device that looks like the offspring of a television remote and a '90s-era cellphone. It is encased in a bright-pink rubber skin, to match her workout gear.

She has other colours, too, for different outfits. The remote controls an implantable pulse generator, a system that is stationed inside her right butt cheek. The generator is connected to a series of thin wires, or leads, that run through her spinal canal and deliver electrical signals to specific spots along her spinal cord. Those signals replace intolerable pain with a dull tingling sensation. By pressing the up and down buttons on her remote, she can adjust the signals' intensity and determine which of several specific areas in her legs and feet receive them. Without it, she could barely get out of bed, let alone pound a punching bag at a gym. Without it, the pain – the result of a disorder that affects more people than you might imagine – would be unbearable. But with the device, McCarthy was recently able to run on the road for the first time in five years. She made it two and a half blocks before she was doubled over and heaving. It felt like a miracle.

**THE PAIN STARTED IN 2008**, when McCarthy, then 25 and living the active life of a vibrant young woman in Manhattan, underwent surgery to remove an accessory navicular bone in her right foot – a fairly routine procedure. On 8 September, she awoke from the operation in agony – as if someone were running a blowtorch up and down her right leg. While firing a nail gun into it.

She tried to reassure herself as she stared up at the ceiling, perspiration beading on her face, that it was normal post-operative pain that would fade. But the next day, back at her parents' house in Danbury, where she'd gone to recover,

On the McGill Pain Index, amputation of a digit without anaesthesia is rated at 40. McCarthy's condition: 42.





it felt just as awful. The day after that, too. She elevated the leg on a stack of pillows outside the bedding, because even a sheet brushing against her skin made her want to scream.

By the third day the foot had swollen so much that it split open the cast doctors had fit over it. When she showered, the drops of water pelting her leg felt like fish hooks. Back in bed she swam in sweat and the haze of her suffering. Painkillers did nothing.

She watched, immobile, as her body attacked her. Within a few weeks the swelling had spread above her ankle, a line of scarlet across her shin. Her toenails grew differently, and the skin on her foot turned a mottled black and purple. The swelling and redness eventually reached her thigh.

By then she had told her firm she didn't know when she would be back to work. She stayed in her parents' guest quarters, her mom having converted her old bedroom into a sewing room. Who could have guessed Molly would be back? She had always been a high-energy, high-achieving type, through university and into the hypercompetitive, on-your-feet world of advertising she loved, partly because it reminded her of sports: the gush of adrenaline that came with making sales, the camaraderie.

Pain and illness happen to everyone, usually unexpectedly. The flu, a broken bone. Explainable things, endurable things. Then there is the kind of suffering that makes life unbearable, made worse by its randomness. McCarthy had been hit by a force like lightning in its intensity and freakishness. What do you do when, in the prime of your life in a big city teeming with people of your age and energy level, you are suddenly bedridden and suffering for no discernible reason?

McCarthy barely moved for days at a time, even though she often couldn't sleep for more than 45 minutes a night. She needed two twin beds pushed together – one for her, one for her leg, to keep it clear of the bedding that felt like a belt sander on her skin – and several fans blowing on her to keep her sweat from puddling. She stared out the window on to the yard where she'd played as a kid, and when it

got dark outside she watched endless hours of TV – *CSI* reruns, *The Biggest Loser*, whatever could distract her from the hurt and the thoughts about what was happening to her leg, her body, her life. Doctors seemed baffled. The pain was bad. Not knowing what was wrong or what to do about it – that was almost worse.

**AROUND THE SAME TIME**, Michael Moffitt and some of his engineering colleagues at the medical-device company Boston Scientific were riffing on the idea of making a better spinal-cord stimulator, a tool some patients use to control chronic pain. An electrical-pulse generator implanted under the skin connects to small lead wires with electrodes implanted in the spinal canal, which in turn deliver a current through a series of thin wires with tips, or contacts, made of precious metals. The current flows to bundles of neurons that are part of the spinal cord, causing a tin-



McCarthy is now an ambassador for patients: "I just want anyone going through what I went through to know it's going to be okay."

gling sensation and relieving pain in a way scientists don't fully understand. "Somehow", Moffitt says, "it changes the signal that's sent to the brain." From burn or stab to a gentle tingle.

Stimulators had been around since the 1960s, but they were clunky devices, typically used as a last resort. Patients had to plug an external battery into an outlet at regular intervals to keep it charged.

Moffitt and his colleagues had already created the Precision in 2005, which advanced the SCS by making the battery rechargeable, typically in one of the patient's buttocks. But they felt they could improve on that model by making it capable of creating precise electric fields that recruit "helpful" neurons; they also hoped to prevent the SCS from sending sensations to the wrong areas, as some did.

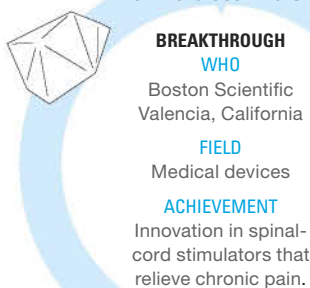
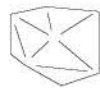
Like other devices of its kind, the Precision maxed out at 16 contacts. The engineers suspected that if they could increase the number of contacts they might improve its therapeutic value. "We didn't have clinical data that convinced us that was the case," Moffitt recalls, "so we took something of a gamble." Over several years of fine-tuning the design, they were able to double the number of contacts without increasing the generator's size. They

also developed a new algorithm that enabled each of the 32 contacts to be operated independently and to be adjusted in 1 per cent increments. More precise, more controllable, and no more obtrusive. Now they needed to know if it would make a difference.

**THERE IS AN OBJECTIVE** measure for pain, a yardstick for hurt, called the McGill Pain Index. Near the bottom, with a score in the low teens, is an ankle sprain. A toothache comes in at 20; up around 40 is amputation



An X-ray taken during surgery of leads implanted in McCarthy's spinal canal.







of a digit without anaesthesia, and childbirth with no epidural. The diagnosis McCarthy received after more than a year of suffering – complex regional pain syndrome – was, according to McGill, worse: 42.

CRPS, also known as reflex sympathetic dystrophy, is a chronic, systemic disorder. Essentially, it's an abnormal response to injury (or, frequently, to surgery) that magnifies the aftermath, almost like an allergic reaction. So you get hurt and there's the normal pain signalling the injury, but then those signals not only get louder than they need to be, they also persist long after the injury or incident is resolved.

The diagnosis was a relief, in a sense, because it explained the pain. But CRPS has no cure. What McCarthy did with this knowledge was to hurl herself at any possible fix that didn't involve taking more medication. She tried physiotherapy. She had eight more operations on her foot, and a dozen anaesthetic injections, known as sympathetic nerve blocks, in her lower spine. With each new procedure she recited the same positive thoughts. This is it. This will make me better. But after a year the pain was still there.

When your ability to do the things you love – run, work, even sleep – is taken away for more than a year, you can slip into a dangerous mode of acceptance. The determination required to get better can wear thin. McCarthy never thought about quitting, but the situation tested her resolve. When a doctor eventually suggested a spinal-cord stimulator, at first she declined. The idea of having a generator permanently implanted in her spine, and the wires and the battery pack and the external charger she'd need to haul around, was too much. But when three more nerve blocks failed, she felt she was out of other options.

**IN SUMMER 2009**, a surgeon implanted McCarthy's first spinal-cord stimulator. The pain let up almost immediately. Within two weeks, she was back at work. She rented an apartment in New York three blocks from the hospital where she'd had her operations. She joined

the New York Sports Club. "I walked into the gym around the corner and told the people at the front desk, 'I've got a generator in my spine, and I need a trainer who can handle that,'" she says.

They assigned her Kevin Mathieu, a boxing enthusiast who would spend the next four years puzzling through a series of primitive devices with McCarthy. The stimulator's battery sometimes died during workouts, forcing them to stop and plug it in. "One thing had a magnet that I used to have to hold while she trained," Mathieu says. "Another had all these wires, and they would go off, and we'd have to stop every 10 minutes to trouble-shoot." The hardware interfered with other aspects of normal life, like going on dates. But most problematic was that the stimulators had crude settings that sometimes dulled the pain – the CRPS symptoms had spread to her left leg and foot – and sometimes did not.

Fortuitously, Boston Scientific was unveiling its improved stimulator last spring, just as McCarthy's frustration was growing. The Precision Spectra would have a 12-year battery that could be implanted and be recharged wirelessly. It would be operated by remote control. And the new algorithm allowed users to position the leads that spiderweb over the spine for maximum benefit. The contacts in the previous model tended to move around over time, making it difficult to optimise their benefits. The new system, which the company calls multiple independent current control, was their "light-bulb moment," Moffitt says.

On June 25, 2013, doctors implanted the Spectra in McCarthy's back. On that day, she says, "they saved my life."

She calls herself Mollybot.

**EVERY YEAR ON THANKSGIVING** the McCarthys travel to Florida. If you had been standing with Molly on the beach last November, you might have noticed a small indentation on her upper spine where a surgeon removed part of one of her vertebrae to accommodate the Spectra. You also might have noted her bare right foot burrowing down into the sand, creating a sensation she hadn't felt for five years.

Every month or so she meets with a company clinician, Colleen Kramer, who connects her computer to McCarthy's stimulator and has McCarthy move through a set of activities – walking, sitting, exercising. During each, Kramer asks McCarthy if she hurts more or less, and where, and then fine-tunes the remote accordingly: Does she need more stimulation in her right foot when she's standing? Less in her left knee when she's sitting?

At a recent meeting, Kramer created a new programme so McCarthy could better manage the aftermath of an upcoming foot operation. As a result, McCarthy says, she was able to work out a couple of weeks after surgery, cutting her recovery period dramatically.

The Spectra now helps a wide range of chronic pain sufferers, including former soldiers who sustained nerve damage in combat. "The hero, to me, is the technology," she says. "I'm just the girl who happens to be living with it."

In Florida, while her family watched, she took off running down the beach, barefoot, loping free and easy, something she hadn't done for a long time. The device beneath her skin had given her not a new life but rather her old one, the only one she ever wanted.

## Total control



McCarthy uses a remote control to adjust the currents in her spinal-cord stimulator, directing which areas of her legs and feet receive its benefits. "The programming is very super-specific," she says. The remote is preset for whatever activity she chooses: there's a setting for long walks, another for sitting at her desk, others for lying in bed and working out, and so on. A smartphone app may eventually replace the remote control. And Boston Scientific might also explore making the stimulator into a smart device – one capable of learning patients' behaviour patterns and body positions and able to self-program accordingly.

# A SMARTER SPACECRAFT

The Ladee lunar orbiter introduces a modular construction system that cuts Nasa's mission costs without compromising the research.

# T

**THE MACHINE THAT FLEW** closer to the Moon than any other unmanned spacecraft in history, collecting gas and dust samples that could one day help mankind reach Mars and sending valuable data to scientists on Earth every minute of its existence, was about the size of a sofa. It rocketed into space and orbited the Moon for 100 days, reaching 6 240 km/h and careering within just a few hundred metres of the craggy surface. On 17 April of this year, with its fuel supply nearly spent, the Lunar Atmosphere and Dust Environment Explorer, or Ladee, was intentionally crashed into the Moon, pulverising the craft into a cloud of dust and vaporised carbon fibre, a spectacular collision heard by no one, seen by no one. Ladee transmitted data until the moment of impact.

## REVOLUTIONARY DESIGN

Ladee's design busted up the traditional Nasa process in the best way. Project manager Butler Hine,

a 22-year Nasa veteran, had been frustrated by the slow pace of new mission launches. He blamed the Nasa pyramid. At the tip – the starting point of any project – perches the scientific objective. From there, multiple teams might spend years custom-designing spacecraft and instrumentation to meet the objective, an expensive and often byzantine process. "We flipped the pyramid on its head," Hine says.

Instead of building Ladee as a one-off spacecraft to fit the mission, they designed a modular system using carbon-fibre units that could be configured like Lego bricks to create craft for a range of missions – at about a tenth of the average cost of missions such as the Mars Science Lab. "The deck was stacked against us," says Hine. "Not only did we have to pull off the mission, but we had to prove our new design

philosophy." It's a radical new system, known as the Modular Common Spacecraft Bus (MCSB). And for any mission team competing for Nasa funding today, it has become the most in-demand platform.

## CLOSER TO MARS

Despite its violent end, Ladee's mis-

sion was an important piece of a long-range plan. Developed at the Nasa Ames Research Centre in Mountain View, California, the craft gathered information about the Moon's exosphere. The sampling and analysis methods will be used with other mission targets, including the Martian moon, Phobos. Some day, when Nasa fulfils its goal of sending a manned expedition to Mars, Phobos will be a way-point, and the data from Ladee's mission will have helped astronauts prepare to land there.

## LIGHT-SPEED COMMUNICATIONS

Nasa personnel bolted to Ladee's body a laser-equipped device that sent and received data. On 17 October 2013, after Ladee had entered lunar orbit, a Nasa crew fired a 20-watt infrared laser into space from a terminal in White Sands, New Mexico. The beam found Ladee 385 000 kilometres away, locked on to the receiver, and made history by downloading data at 622 megabits per second – more than six times faster than the quickest space-based radio signals. Nasa's director of optical communications, Don Cornwell, compares the system with the fibre optics that drive the Internet (but without the glass cables to channel the laser). The benefits are big. "To make a Google map of Mars using the best radio technology available would take nine years," Cornwell says. "With lasers it would take nine weeks." – *Logan Ward*

**BREAKTHROUGH**  
WHO  
Nasa  
Mountain View, California  
**FIELD**  
Spacecraft design and communications  
**ACHIEVEMENT**  
Modular, flexible construction; data transfer by laser.



**TERRANCE LI**  
Seventh Grade  
Odle Middle School  
Bellevue, Wash.

## NEXT GENERATION

### THE CHARGING PAN

Li, now 13, made a smartphone charger that draws power from dissipating household cooking heat. "The world already has a lot of machines that waste a lot of heat – that have very low efficiency, like engines and stuff – so I decided to harvest this heat energy."

He rigged up a saucepan with thermoelectric tiles on the bottom wired to a USB charging port. Heated up the pan, added cold water. The temperature differential created electricity (via something known as the Seebeck effect) that flowed to the USB port. Li plugged in and charged his smartphone.

**RECOGNITION** Google Science Fair: Americas Regional Finalist; *Scientific American* Science in Action Award Finalist





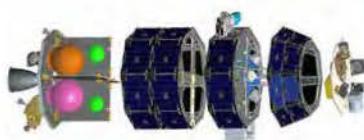


## THE CLOSEST UNMANNED LOOK AT THE MOON – EVER

▲ While flying over the Montes Agricola mountains and the Raman Crater, which is 10 kilometres in diameter, Ladee's instruments picked up heavy readings of an argon isotope – evidence, researchers believe, that parts of the Moon's mantle are molten.



▲ An artist's rendering shows Ladee approaching lunar orbit. Flight controls are clustered on top of the carbon-fibre body, which carries the science instruments; the large and small thrusters hang below the craft's lower deck.



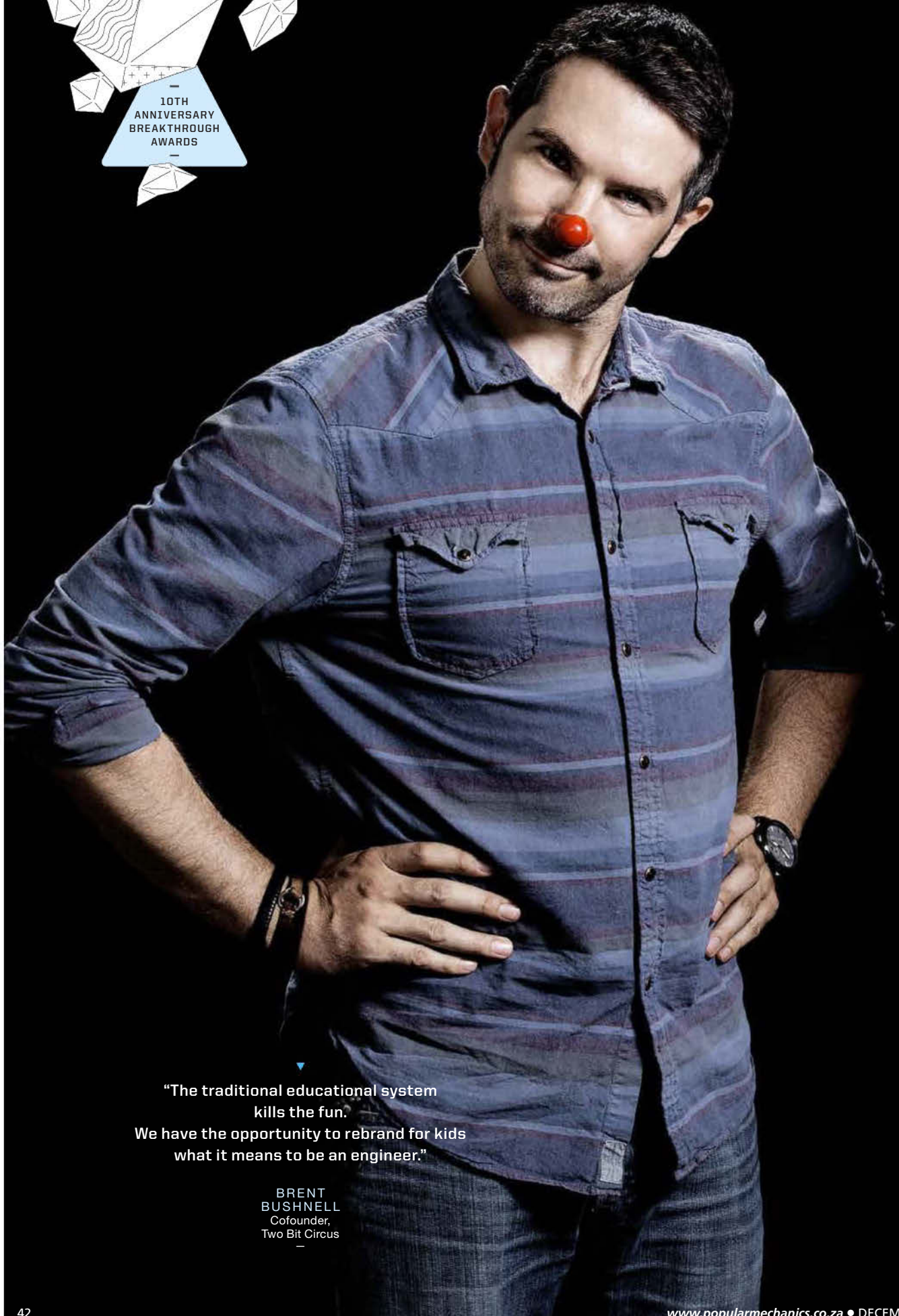
### ▲ MODULAR DESIGN

The standardised centre pieces (the extension, payload, and bus modules; left to right) made Ladee much cheaper and customisable to the mission.

### ▲ GETTING READY TO FLY

Engineers install Ladee into the fairing of the Minotaur V rocket at Nasa's Wallops Flight Facility in Virginia.



A full-page photograph of a man with dark hair and a beard, wearing a blue and grey striped button-down shirt and jeans. He has a red nose on his nose and is smiling slightly. His hands are on his hips. The background is dark. In the top left corner, there is a graphic of several white geometric shapes (polyhedrons) of different sizes, some with internal patterns. In the bottom right corner, there is a similar graphic of white geometric shapes.

10TH  
ANNIVERSARY  
BREAKTHROUGH  
AWARDS

“The traditional educational system  
kills the fun.  
We have the opportunity to rebrand for kids  
what it means to be an engineer.”

BRENT  
BUSHNELL  
Cofounder,  
Two Bit Circus



# THE NEW TEACHERS

These two gentlemen want to make learning about science, maths, and technology fun. So they created the world's most ambitious educational carnival. Kids love carnivals.

**B**RENT BUSHNELL can summarise his plan for overhauling how we teach kids the essential subjects of science, maths and engineering – all disciplines children have struggled with mightily for nearly a generation – in three words: lasers, fire and robots.

Bushnell, the 36-year-old CEO of the startup Two Bit Circus, talks in roiling torrents and calls himself and his cofounder, Eric Gradman, “giant nerds”. But his dead-serious ambition is to make STEM subjects – that’s the acronym for science, technology, engineering and maths – more attractive to kids by making them more fun. The company’s bedrock creation is the STEAM Carnival (the extra vowel is for art), which debuted over an October weekend in a 4 600 m<sup>2</sup> Los Angeles warehouse. The carny is a kind of Trojan horse for the STEM curriculum: lure kids in with attractions they’re reflexively drawn to – concerts featuring robots, interactive experiences, contests, prizes and games – and you can fill their heads with science-y things they never knew they wanted to know.

The games form the thumping heart of the enterprise. Bushnell, the son of Atari founder Nolan Bushnell, connected with Gradman to create technology-focused amusements for a monthly San Francisco social gathering called Mindshare. (Bushnell describes it as a “drinking club with an art problem”.) When they noticed how the games electrified the room, the two men realised they had a business plan and quit their “traditional STEM jobs” to start Two Bit.

STEAM games include a motion-capture mechanical bull and a laser-maze limbo, in which participants wend over and around beams like burglars in an art-heist movie. Wield a sledgehammer in the Jacob’s ladder game and you send lightning-bolt voltage shooting up the pole to ring the bell. Toss a ring over a milk bottle and a fireball detonates from its mouth. Unlike old-school carnival games, whose secrets remain concealed, the STEAM versions come with engaging explanations of their underlying science and technology.

There’s a curriculum for participating schools, with six weeks of hands-on learning that culminates in, say, the creation of a wearable device for a fashion show. “There’s all this crazy, awesome stuff you can do now,” Bushnell says. “In a weekend we can build a robot that controls shit in outer space. If kids had a better sense of what was possible, they would be excited about it, too. We believe it’s the new rock and roll.”

Rock and roll never had robots. Lasers and fire, yes. But not robots. This just might work. – *David Howard*

## BREAKTHROUGH

### WHO

Brent Bushnell and  
Eric Gradman  
Two Bit Circus  
Los Angeles

### FIELD

Education

### ACHIEVEMENT

Making kids want  
to learn.

ERIC  
GRADMAN  
Cofounder,  
Two Bit Circus

# A BETTER WAY TO POWER THE TROOPS



A wearable solar-energy system drastically reduces the weight that US Marines carry into battle – and helps them survive.



## MAPS' COMPONENTS AND CONFIGURATION

- 1) High-efficiency photovoltaic solar panel
- 2) Rechargeable battery
- 3) AA-cell-battery charger
- 4) PRC-153 person-to-person radio and recharging pouch
- 5) PRC-152 satellite-communication radio, also in recharging pouch
- 6) Vest Power Manager input/output hub
- 7) Hand grenades in pockets
- 8) Ammunition magazines, also in pockets

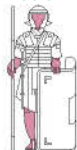


## A brief history of combat gear

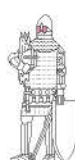
**HOPLITE**  
(8th century BC)  
40 kg  
Body armour made up half the weight carried by Greek heavy infantry.



**IMPERIAL ROMAN ARMY**  
(AD 3rd century)  
43 kg  
Warriors lugged about 15 kg of axes and other trench-digging tools.



**KNIGHT**  
(13th – 14th century)  
45 kg  
Needed really big horses to charge into battle wearing 40-plus kg of armour.



PHOTOGRAPHS BY JOEL STANS  
ILLUSTRATIONS BY FRANCESCO MUZZI





# W

**WHEN A MARINE SUITS UP** for a long patrol – say, five days – batteries and drinking water account for as much as 27 of the 40-plus kilograms he carries. The water is vital. The batteries are equally important, because success in battle increasingly requires fast, coordinated, and precise movements at any given moment, and that kind of mobility calls for devices that eat up battery life: night-vision goggles, radios, GPS, a laptop, and more. It's a conundrum. The gear that enables swiftness creates a load that slows you down.

The solution is the Marine Austere Patrolling System, or MAPS. The US Marine Corps Expeditionary Energy Office (E2O) led the development of MAPS, a vest that strips away up to half of the weight a Marine normally bears above the waist. Consisting mainly of a solar-energy harvesting and storage system and water-purification unit, MAPS has been through several field tests, most recently in July. The majority of the Marines who used it were impressed. "If I were going to Afghanistan, I would want this," one team leader

said. Troops without MAPS found themselves recharging batteries in fellow Marines' USB-equipped MAPS packs.

"One of the tests involved four days of climbing up and down mountains in the Sierra Nevadas," says E2O's Captain Anthony Ripley. "The Marines using MAPS were the only ones not to require battery resupply. Everyone benefited, from individuals in the test squad to the whole rifle company."

MAPS uses a 23 x 36-cm photovoltaic panel and a rechargeable battery that weighs less than 1,5 kilograms, up to 9 kilograms less than the batteries that a soldier now carries. (The MAPS energy and water-purification components together weigh about 4,5 kilograms.) A second pack can be swapped in to feed rechargeable AA batteries, which power weapon-mounted devices such as night-vision scopes. The panel works whether it's stashed in a transparent sleeve on the vest or taken out for maximum exposure to the Sun.

Issues remain – in extreme cold the water-purification unit freezes and the batteries fail to hold a charge, and in heavy shade the panels don't operate – but fixes are in progress. For instance, adding power-generating knee braces to provide electricity in the absence of sunlight. Over the next two years MAPS will undergo bulletproofing and further testing to prepare it for use in battle. "Wearable energy is on its way to being combat-ready," Ripley says. "What we're trying to produce is a self-sustained war fighter."

MAPS is a significant step towards that goal. – Joe Bargmann

## BREAKTHROUGH

### WHO

USMC Expeditionary Energy Office (E2O),\*  
Arlington, Virginia

### FIELD

Military technology

### ACHIEVEMENT

Lightweight solar power system for Marines on patrol.

\* E2O PROJECT PARTNERS: NAVAL SURFACE WARFARE CENTER DAHLGREN DIVISION, U.S. NAVAL RESEARCH LABORATORY, PROTONEX TECHNOLOGY, MICROLINK DEVICES

**US PARATROOPER OVER NORMANDY**  
(1944) / 36 kg

After touching down, a jumper ditched all but his core kit to lose some of those 36 kilograms.



**US ARMY INFANTRY, KOREA**  
(1951) / 38 kg

The heavy load led inexperienced soldiers to jettison gear they'd actually need later on.



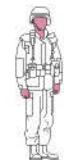
**US ARMY INFANTRY, VIETNAM**  
(1967) / 35 kg

Jungle warfare favoured a light kit, but men held on to essentials such as ammo and mosquito nets.



**US ARMY INFANTRY, DESERT SHIELD**  
(1990) / 45 kg

Supply-line problems forced soldiers to carry everything on their person.

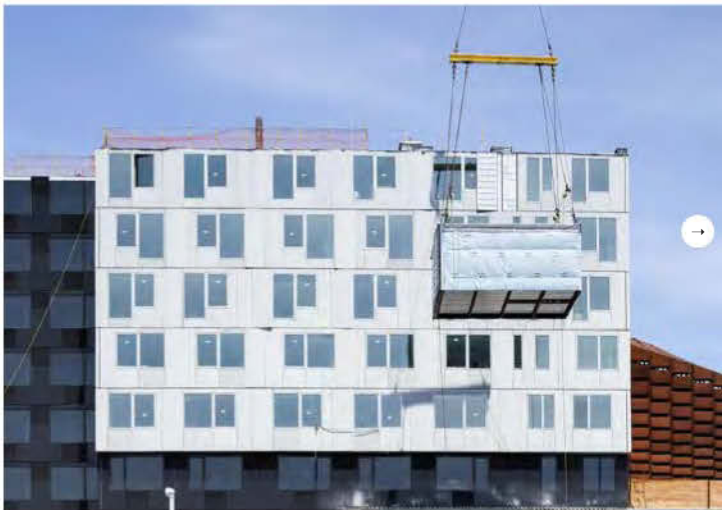


**US ARMY INFANTRY, AFGHANISTAN**  
(2003) / 43 kg

Armour got lighter, (8 kg), but the sheer amount of stuff created the big load.







**SHILOH CURTIS**  
Junior  
Laughing Thunder  
Academy Sunnyvale,  
California

#### NEXT GENERATION

#### HAT-BASED, HANDS-FREE HAPTIC NAVIGATIONAL AID FOR THE VISUALLY IMPAIRED

Every great invention starts with a premise. This is how Curtis, 15, describes hers: "A robot is blind until you put sensors on it. Why don't we put sensors on the blind so that they can navigate like robots?" She cribbed a laser distance sensor from a vacuum cleaner and connected it to a network of vibrating motors like the ones in cellphones, and then embedded the system in a hat. A computer programme that Curtis wrote triggers the motors at different spots on the band, indicating the direction and proximity of an obstacle. Tests with blind-folded subjects were successful; trials with the visually impaired are up next.

**RECOGNITION** California State Fair: Project of the Year; Google Science Fair: Americas Regional Finalist







# THE PREFAB HIGH-RISE

# A

**AT THE 461 DEAN CONSTRUCTION** site in downtown Brooklyn, there is no barking foreman. There's no screeching chop saw or pounding jackhammer. The loudest thing you hear is a hand-driven pulley, rattling like an anchor chain through a hawsehole as a lone worker in a hard hat uses it to tension the lift cables attached to what looks like a particularly sleek trailer home.

## **BREAKTHROUGH** **WHO**

David Farnsworth,  
Roger Krulak  
New York City

## **FIELD** Architecture

## **ACHIEVEMENT** Building the United States' first modular skyscraper.

Except it's not a trailer home. It's a finished apartment. Sitting on a flatbed.

This is America's first high-rise modular tower and only the second worldwide. Unlike every other construction project, it's not built piece by piece on site. Instead, it's assembled unit by unit in a factory about 2 kilometres away. The apartment modules arrive at the tower site virtually

finished: bathrooms plumbed, paint dried, refrigerators installed. Each is hooked to a crane, lifted up eight storeys – out of an eventual 32 overhead – and guided on to four precisely placed setting pins. With a click, someone's new home is all but ready for move-in. The whole process takes less than 12 minutes.

A project of 461 Dean's scale involves many people, but it was primarily the brainchild of two: Roger Krulak, a senior vice president at Forest City Ratner, a leading property developer in New York; and David Farnsworth, a principal with Arup, the famed architectural engineers. They met in 2008, when the Great Recession had put a premium on streamlined construction methods. Despite finding that modular high-rise construction was both plausible and cheaper than conventional methods, with big money for

"It's really not mass production.

It's mass customisation,"

says David Farnsworth, one of the architectural engineers behind the building.

"Out of 930 modules on the whole project, we have 225 unique structural types."

# THE BENEVOLENT OVERLORD

Facebook has studied 700 000 users without their consent. Everyone who claims to be outraged is missing the point.

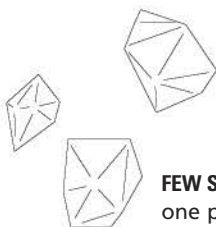
BY BILL GIFFORD

projects tight, the two had to put their idea on the shelf – until Forest City Ratner CEO Bruce Ratner saw a viral video of a Chinese company building a hotel in 15 days. He sent Krulak an email: “How do we build this here?”

The answer was to design a factory, and then design a building that could be put together on a factory assembly line. FCS Modular, a joint venture between Forest City and the Swedish firm Skanska, leased a former covered dry dock in Brooklyn’s Navy Yard, and Krulak and Farnsworth worked to perfect the process. Unfortunately they couldn’t perfect the partnership, as FCS and Skanska are currently at a legal impasse, but the two men did create a system that will revolutionise construction.

A long, tall, hangar-like building, the factory is meticulously organised. Construction materials that were delivered in bulk are separated into build kits for each apartment module, then assigned to subassembly areas – wall-framing, bathrooms, electrical – spread along one long wall. Along the other, the steel module frames – welded in Virginia and trucked to Brooklyn – are dry-fitted. (Laser-aligned jigs get the tolerances to within as little as 3 millimetres.) Drywall, cabinetry and appliances go in, and the external facades are attached. Finally, the apartments are painted, weather-wrapped and trucked to an outdoor staging area to await their lift.

The key, Krulak explains, is the welding of detailed design to standardised production. On a conventional site, workers build from a fairly crude set of construction drawings. Getting everything to fit involves a surprising amount of improvisation. By contrast, 461 Dean is built from blueprints of the sort used in the aerospace industry. The placement of every component is predetermined and referenced to a single, fixed point – no on-the-fly measuring required. “Two guys working off a plan like this can build 20 walls a day,” Krulak says. “In a period of three days you’re building all the walls for a whole floor.” And in two years you’ve got yourself a high-rise. – *Tim Heffernan*



# F

**FEW SCIENTIFIC STUDIES HAVE EVER GENERATED MORE OUTRAGE** than the one published in June by the journal *Proceedings of the National Academy of Sciences*. In it, researchers revealed that they had altered the Facebook feeds of nearly 700 000 users. Some users were shown more “happy” posts, while others saw more negative content – all without their knowledge, of course. The researchers, working with

Facebook, then tried to measure the readers’ emotional responses.

After the study was published, some flipped out. Users pelted Facebook with angry comments, tweets and posts. The journal itself issued an “Expression of Concern”, saying “the collection of the data by Facebook may have involved practices that were not fully consistent with the principles of obtaining informed consent and allowing participants to opt out.” One of the authors, Facebook engineer Adam D I Kramer, posted his own apology on his Facebook page: “Our goal was never to upset anyone,” he wrote. Jaron Lanier,

writing in *The New York Times*, said that if the study had been

government funded, “such a complacent notion of informed consent would probably have been considered a crime”. Yet almost nobody said what they should have, which was, “Cool.”

Facebook is a vast petri dish of human connectedness. For researchers, it presents a writhing, roiling, and endlessly fascinating data set – an opportunity to listen in on hundreds of millions of conversations every day.

“I’m not sure there’s a more valuable resource that’s ever been created for social science research,” says James Fowler, a professor at the University of California, San

**BREAKTHROUGH**  
WHO  
Facebook  
Menlo Park, California

**FIELD**  
Social sciences

**ACHIEVEMENT**  
Studies that shed new light on human behaviour.



—  
**KENNETH SHINOZUKA**  
Sophomore  
Horace Mann School  
Bronx, NY

## NEXT GENERATION

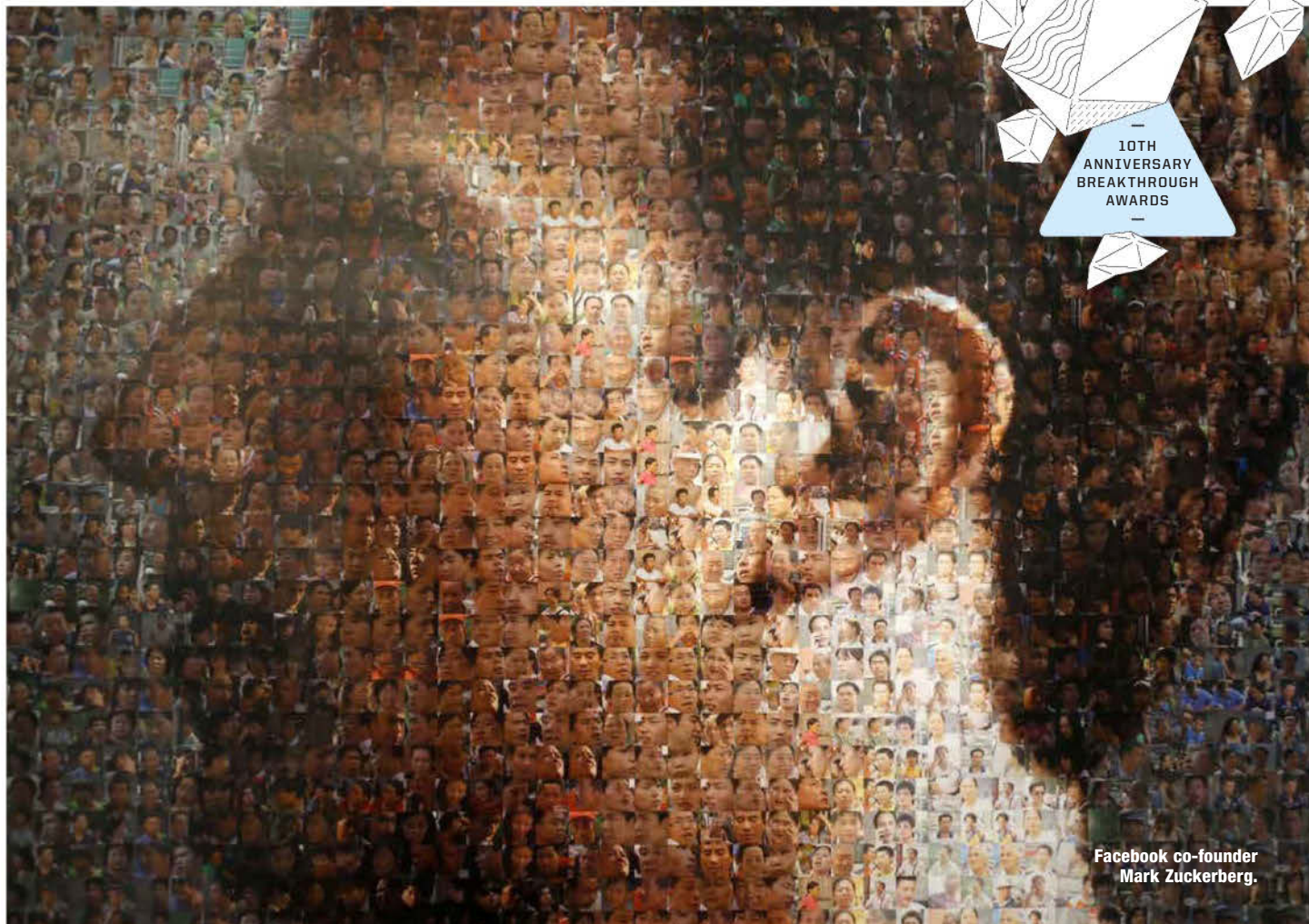
### WEARABLE SENSORS

*A novel healthcare solution for the ageing society*

—  
People who need 24/7 care, like advanced Alzheimer’s patients, sometimes get out of bed in the middle of the night and wander around, a serious health hazard. Shinozuka, now 16, designed a Bluetooth-enabled pressure-sensitive system with a sensor thin enough to put in socks. Footsteps send signals to alert caregivers that a patient is on the move. Shinozuka patented the invention, which is now in testing at elder-care facilities.

—  
**RECOGNITION** Google Science Fair: Global Finalist; Scientific American Science in Action Award





GREATSTOCK/EPA

Diego, and coauthor of *Connected*. "There's a thousand years' worth of work to be done there, and I'm only going to get to do 20 of them." Fowler has teamed with Facebook on several projects, including a study on how social media affected voter turnout for the 2010 US midterms. They showed get-out-and-vote messages to 61 million people and measured the outcome; it turned out those who saw pictures of close friends with a message were more likely to vote. "It worked out to a quarter-million more people voting," says Fowler, "and we didn't hear any blowback at all."

The more recent study was innocuous, compared with such manipulation of the democratic process. It examined the trope that Facebook posts about people's perfect lives make others feel sad about their own existences. It found the opposite, by a slight margin: happiness is slightly contagious.

Another discovery: if you mess with people's kitten-video feeds, they get angry. But here's a news flash: if someone is trying to sell you something, chances are they're also trying to manipulate you in some way. All the time. Big companies do research on customers every day. It's why stores put sugary cereals at a level where the characters on the boxes can look kids in the eye. The difference is Facebook published the findings, along with dozens of other papers it collaborates on annually.

In his apology, Kramer made an interesting point: "The goal of all of our research at Facebook is to learn how to provide a better service." In other words, it's a product. You are its consumers. Caveat emptor.

We swim in a sea of electronic information. And although we should know better by now, we still delude ourselves that what we see on our screens somehow represents an objective, unfiltered

3 000 000  
—  
Number of posts  
analysed in  
the experiment,  
containing more than  
122 million words

reality. We think the Internet isn't pushing our buttons. The emotional-reaction study shattered that illusion, if only briefly. And it isn't only Facebook; Google has admitted to manipulating search results, tweaking its algorithm to try to bury sites it deemed spam and content farms such as *livestrong.com*. It could do the same for less honourable reasons. A few years ago I searched for "worst president ever," and the top result was then-president George W Bush's official White House page. Amazon does it, too, most recently by hiding or removing the Buy button for titles published by Hachette Book Group, a publisher with which it is in a dispute.

These are just some of the examples we know of. The happiness study was a useful wake-up call: you're not just checking Facebook; it's checking you. But Facebook stands out for sharing what it learns in ways that could benefit all of us.

# A ROBOT FOR ANY DISASTER

The Pentagon's humanitarian android is getting closer to replacing first responders who risk their lives after a catastrophe.

**THERE'S AN AMAZING VIDEO** on YouTube of the world's most advanced humanoid robot. The footage shows it in a series of testing rooms, with engineers popping in and out – monitoring the machine, tapping out commands on keyboards, smiling at one another with what looks like pride, or shock, or both. In one clip the robot walks on a treadmill with astonishing smoothness. An engineer slips a wooden post under its foot – simulating an obstacle on some rocky terrain, we are to assume – and the robot ably steps over it. Cut to the robot standing on one foot and getting clocked in the side with a 20-kilogram ball, then adjusting its body to stay balanced. Cut to the robot navigating a treacherous hole in a hallway floor by pressing its arms against the walls, suspending

itself over the void and inching along until it reaches safety.

It runs with agility. It reaches for objects fluidly. It moves with purpose.

It moves like a human.

Atlas was designed by Boston Dynamics, a leading robotics company, under contract with the Pentagon. The goal was to create a bot that could replace rescue workers in dangerous areas – Yosemite during last

year's wildfires, for example, or the Philippines after a massive typhoon, or Napa, California, after the 6.0 earthquake in August. Thousands of first responders each year are put in danger, or die, at such sites. The 1.9-metre, 150-kilogram Atlas uses hydraulically driven joints to exert massive force – one kick can turn a brick into crumbs. Hydraulics also allow Atlas to right itself if it's thrown off balance. When Atlas runs, range-finding sensors render the way forward in 3D so it won't trip. Tools such as screwdrivers fit onto its articulated hands.

Atlas's origins date back to the 1980s, when roboticist Marc Raibert built a pogo stick with dynamic balance at his Carnegie Mellon and MIT labs. By 1992 he had founded Boston Dynamics, assembling self-balancing robots. One was Petman, Atlas's predecessor,

built from 2009 to 2011.

When an earthquake and tsunami caused a catastrophic nuclear meltdown at Japan's Fukushima Daiichi plant in 2011, the search-and-rescue bots at the time proved painfully inadequate. Automotons had been developed for disasters going back to Three Mile Island in 1979, Chernobyl in 1986, and the 9/11 attack sites, but those robots had sensors and cameras for locating

victims and mapping the site – and few other capabilities. To accelerate the development of truly useful humanitarian robots, the Pentagon in 2012 launched the DARPA Robotics Challenge (DRC), out of which Atlas grew.

A team of about 30 Boston Dynamics engineers evolved Petman into Atlas for the DRC. They unveiled the robot in July 2013. In October, the company began upgrading Atlas's arms and battery, and will eventually cut its power cord.

Now teams in the DRC challenge – more than half using the Atlas platform – are deciding how much control to maintain over the machine and how much they want Atlas to decide on its own. "The pinnacle for us will be getting to the sweet spot where the human contributes only what humans do better than computers," says Russ Tedrake, leader of Team MIT.

Atlas currently lacks the dexterity to extract a person trapped in rubble. But if you watch the video, you can see Atlas being useful even now – knocking down a wall, lifting huge rocks, traversing a muddy pit. All of these actions will help the robot get to survivors after a disaster strikes. We hope one never does. We know it will.

– DAVEY ALBA

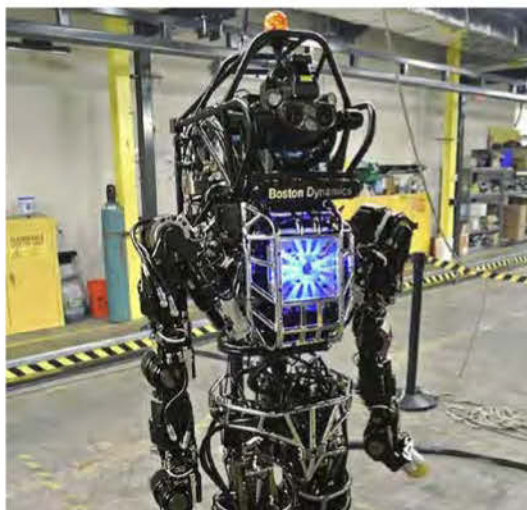
**BREAKTHROUGH**  
WHO  
Boston Dynamics  
Waltham, Massachusetts

**FIELD**  
Humanoid Robotics

**ACHIEVEMENT**  
Creating a semi-autonomous search-and-rescue robot.

## SUPERSTRONG

Hydraulics drive Atlas, making it much more powerful than electrical robots.



KAMILA KRAWCZUK  
Eighth Grade  
Pope John Paul II School  
New Britain, Connecticut

## NEXT GENERATION

### THE DRAWING ROBOT

Krawczuk, 13, applied her knowledge of electrical engineering, computer coding (at which she is self-taught), and calculus to make a robot capable of writing her school's initials. What were you doing when you were 13? Right. Exactly.

**RECOGNITION** Four major awards, including the Xerox Computer Science Awards, First Place, Middle School





# THE PRINTABLE CAR

The average car is made of 25 000 parts from around the world. With its 3D-printed shell, Local Motors' Strati has just 64.



## PROCESS

The Strati's 3D-printed tub will be a single piece of carbon-reinforced plastic.

**J**AY ROGERS HAS THE KEYS to a 3D-printed car – in fact, the first-ever 3D-printed car. It's a humble machine, an overgrown go-kart built around a 3D-printed tub. The 48-volt electric drivetrain is bolted to an aluminium subframe in the rear, and the seats are printed into the tub and covered with scraps of padding. The contraption looks like a misbegotten extraterrestrial rover, but Rogers, co-founder and CEO of small-batch car company Local Motors, thinks the prototype represents a revolutionary kind of transportation: simple, light, inexpensive, and highly personalised. "There are 25 000 parts in a normal production car," Rogers says. Local's first production 3D-printed car, a sporty two-seater named Strati, will use, by his count, about 64.

The tub for Rogers' prototype vehicle was made in four interlocking sections because no 3D printer was large enough to spit out a whole car. But that's about to change now that Local has partnered with Cincinnati Incorporated, a machine-tool manufacturer, and the US Department of Energy's Oak Ridge National Laboratory, a science and technology research centre near Knoxville, Tennessee. Together they created a larger

printer – a car-size printer. And in the process devised a new approach to direct digital manufacturing.

"People were using 3D to mimic steel or parts we have now," Rogers says. "They're trying to print things that look perfect. The way we're thinking is, stop trying to make the 3D printer do everything." Instead, the new printer quickly generates a shape that approximates the final product, and a milling machine finishes the job. The idea is to print a single piece of carbon-reinforced plastic with no separate chassis or body. Peripheral parts – suspension, wheels, the motor and battery – are bolted on.

Local selected the Strati's design through a crowdsourcing competition, but cars could eventually take any shape, with designers turning CAD files into reality with a turnaround time – and price – unheard of in traditional manufacturing. Rogers figures the raw material to print a two-seater in carbon-reinforced plastic costs about R240 000.

Every car on the road contains tens of thousands of individual parts, each of them a supply-chain, inventory, and assembly challenge. Rogers thinks the 3D alternative could take root faster than anyone expects. "My vision is that this is disruptive innovation," he says. "This is something we have to pay attention to." When the first Strati hits the street, it'll mark a simple but profound change in vehicle manufacturing: forget the parts. Just make the car. – EZRA DYER

## BREAKTHROUGH

### WHO

Local Motors, Phoenix

### FIELD

Automotive Manufacturing

### ACHIEVEMENT

Designing the first 3D-printed car.

2005

#### LEADERSHIP AWARD

**Hugh Herr**  
MASSACHUSETTS  
INSTITUTE  
OF TECHNOLOGY (MIT)  
Biomechanics  
expert and amputee  
walks using devices he  
designed.

#### SOLAR PANELS ON A PLASTIC STRIP

**Alan Heeger**  
UNIVERSITY OF  
CALIFORNIA,  
SANTA BARBARA

#### BRAIN-COMPUTER INTERFACE

**John Donoghue**  
BROWN UNIVERSITY

**FAST-ACT CHEMICAL  
WEAPONS NEUTRALISER**  
**Kenneth Klabunde**

#### BEAMR SYSTEM

**Penn State University  
Team**  
Purifies water, creates  
hydrogen.

#### M249 GUN MOUNT FOR US ARMY HUMVEES

**Michael Pottratz,  
David Russell**  
ADVANCED WELDING AND  
MANUFACTURING

#### ROCKET-POWERED BICYCLE

**Tim and Sarah Pickens**  
Father-daughter  
team, avid Popular  
Mechanics readers.

#### ZOE, ROBOTIC ROVER

**David Wettergreen**  
CARNEGIE MELLON  
UNIVERSITY

#### X-43A SCRAMJET

**NASA**  
The 11 000 km/h plane.

#### NEXT GENERATION

**ATMOSPHERIC AIR-  
SAMPLING KITE**  
**Sarah Mims**

#### PRODUCTS

Xbox 360, First Alert  
OneLink, GM 3.9-Litre V6,  
AMD Athlon Dual-Core  
Microchips, Stanley  
FatMax TLM100, Mac OS  
X v10.4 Tiger, Milwaukee  
V28 Series, Slingbox,  
TomTom Go, Toyota Twin-  
Chamber Airbag

#### 10TH ANNIVERSARY BREAKTHROUGH AWARDS

2006

#### LEADERSHIP AWARD

**Burt Rutan**  
SPACESHIPONE  
Won \$10 million Ansari  
X Prize.

#### BIGDOG PACK ROBOT

**BOSTON DYNAMICS**

#### LOW-COST HYDROGEN

**GE GLOBAL RESEARCH**

#### TESLA MOTORS' ELECTRIC SPORTS CAR

**Tesla cofounded in 2003  
by Martin Eberhard**  
And you thought **Elon  
Musk** invented it.

#### ARTIFICIAL HUMAN BLADDER

**Anthony Atala**  
WAKE FOREST UNIVERSITY  
**Alan Retik**  
BOSTON CHILDREN'S  
HOSPITAL

#### THE FULL BELLY PROJECT

**UNIVERSAL NUT SHELTER**  
**Jock Brandis**  
After Brandis  
introduced his device  
to MIT students, they  
distributed it to the poor  
in Ghana and Zambia.

Tesla is now run by Musk.

Another Boston Dynamics robot.

2007

#### LEADERSHIP AWARD

**Amory Lovins**  
ROCKY MOUNTAIN INSTITUTE  
Energy-efficiency expert.

#### FAB AT HOME DESKTOP 3D PRINTER

**Hod Lipson**  
CORNELL UNIVERSITY  
Lipson said the 3D  
printer, then called a  
fabber, was "a revolution  
waiting to happen."

#### DARFUR REFUGEE COOKSTOVE

**Christina Galitsky,  
Ashok Gadgil**  
LAWRENCE BERKELEY  
NATIONAL LABORATORY

#### PROTO 2 PROSTHETIC ARM

**Stuart Harshbarger  
and Team**  
JOHNS HOPKINS  
UNIVERSITY

#### MULTITOUCH COMPUTING

**Jefferson Han**  
NEW YORK UNIVERSITY  
Han wrote a program  
to let multiple users  
manipulate images on a  
computer screen at once.

2008

#### LEADERSHIP AWARD

**Amy Smith**  
MIT D-LAB  
The leading academic in  
appropriate technology.

#### PHOENIX MARS LANDER MISSION

**Peter Smith**  
UNIVERSITY OF ARIZONA,  
PROJECT LEADER

#### WATER-PURIFICATION POWDER

**Greg Allgood**  
PROCTER & GAMBLE

#### 3D MOTION CAPTURE

**Organic Motion  
Stage Systems**  
Maps human motion for  
applications in health-  
care, the arts and more

#### APTERA TYP-1E ELECTRICAL VEHICLE

**Steve Fambro**  
APTERA  
Aptera folded in 2011.

#### BLOOD BIOPSY CHIP

**Mehmet Toner**  
HARVARD-MIT HEALTH  
DIVISION OF SCIENCES  
AND TECHNOLOGY

2009

#### LEADERSHIP AWARD

**Dean Kamen**  
Founder of FIRST,  
a robotics competition  
for teens.

#### DEEP-STORAGE BATTERY

**Grover Coors,  
John Watkins**  
CERAMATEC

#### FLYING DUNE BUGGY

**Steve Saint**  
I-TEC  
For rugged humanitarian  
missions. Or just because.

#### KEPLER MISSION

**William Borucki,  
Principal Investigator**  
Found numerous  
Earth-like planets in  
the habitable zones of  
other solar systems.

#### MICROBIAL FUEL CELL

**LEBONÉ, HARVARD**

#### NATAL

**Kudo Tsunoda, Alex  
Kipman, Don Matrick**  
MICROSOFT  
Now you know it as  
Kinect.

# 10 YEARS OF GENIUS

#### WINDBELT ELECTRICITY GENERATOR

**Shawn Frayne**  
HUMDINGER WIND ENERGY

#### LENGTH-MORPHING HELICOPTER ROTOR

**Farhan Gandhi**

#### NEXT GENERATION

#### WATER PURIFICATION SYSTEM

**Kelydra Welcker**  
PARKERSBURG SOUTH  
HIGH SCHOOL, WEST  
VIRGINIA

#### PRODUCTS

Apple iPhone, Ford Sync,  
Hitachi Power Tools  
CR13VBY, LG Super  
Blu Player, Microsoft  
Surface, Nintendo Wii  
Fit, Samsung Solid-State  
Drive, SafeTouch Glass  
fibre-Free Insulation,  
BMW Two-Mode Hybrid,  
Zonbu Zonbox

#### SUNCATCHER

**STIRLING ENERGY  
SYSTEMS AND SANDIA  
NATIONAL LABORATORIES**

#### SOLID-STATE HEAT ENGINE

**Lonnie Johnson**  
JOHNSON  
ELECTROMECHANICAL  
SYSTEMS

#### SYNTHETIC OIL

**AMYRIS  
BIOTECHNOLOGIES**  
Amyris's microbe-  
produced diesel is for  
sale in Brazil.

#### NEXT GENERATION

#### ALL-TERRAIN WHEELCHAIR

**INTELLIGENT MOBILITY  
SOLUTIONS**

#### PRODUCTS

Amazon Kindle, Caroma  
Dual Flush Toilet,  
Craftsman Nextec  
Multi-Saw, Intel Atom  
Processor, Livescribe  
Smartpen, Microsoft  
Photosynth, M-Spector  
Digital Camera, Nissan  
Around View Monitor,  
Potenco PCG1 Generator,  
Spore Video Game

#### MINI-HELICON PLASMA THRUSTER

**Oleg Batishchev**  
MIT

#### PAPER MICROFLUIDICS

**THE WHITESIDES  
RESEARCH GROUP,  
HARVARD**  
The Whitesides team  
has since patented  
several iterations  
of its lab-on-a-chip  
technology.

#### SIKORSKY X2 TECHNOLOGY

**Steve Weiner**  
SIKORSKY AIRCRAFT

#### NEXT GENERATION

#### SPHERICAL ROBOT

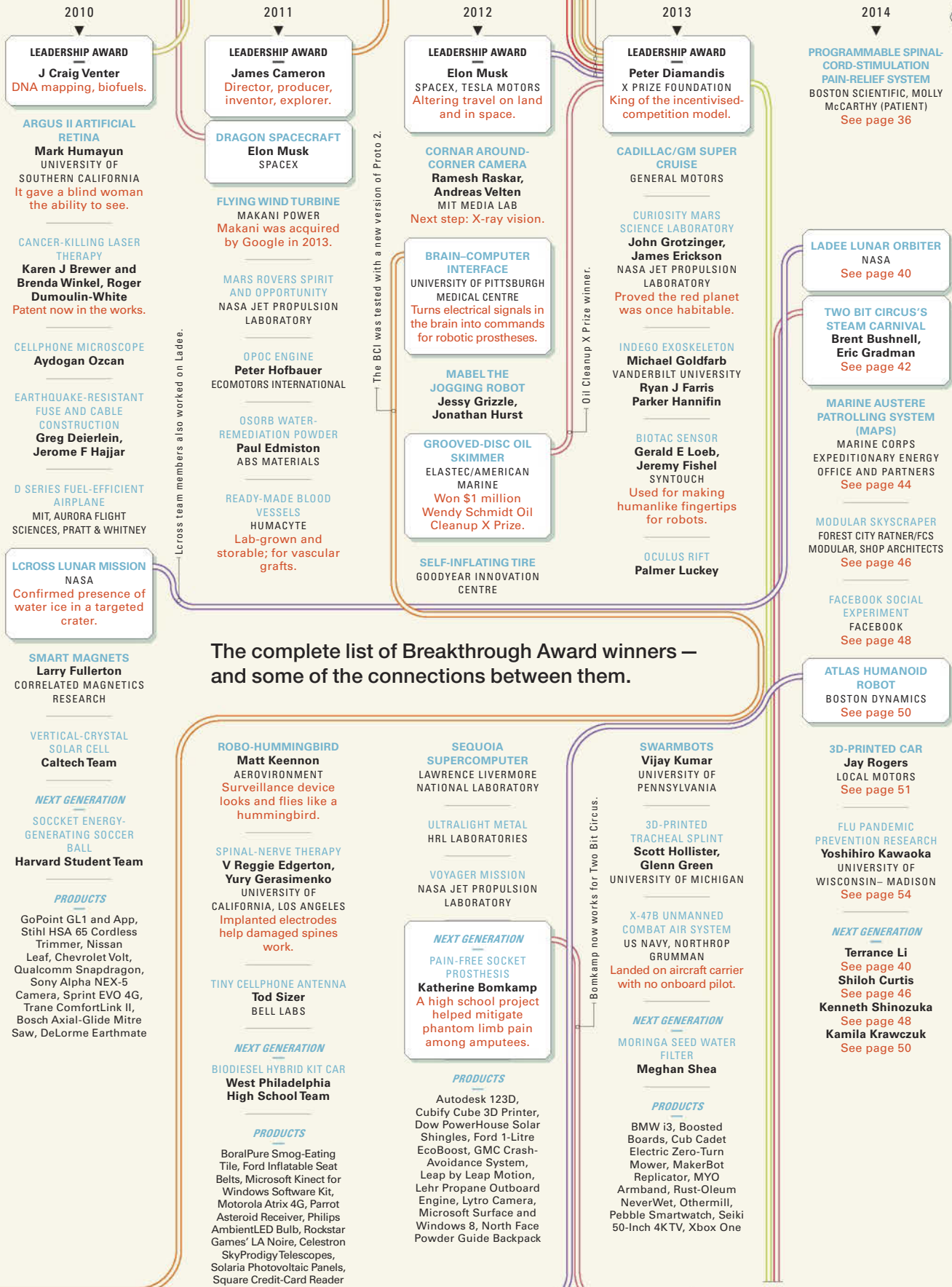
**Gregory C Schroll**

#### PRODUCTS

TechCrunch CrunchPad,  
Andalay AC Solar Panel,  
Ford EcoBoost V6,  
Honeywell Wind Turbine,  
Hustler Zeon Electric  
Mower, LoggerHead  
Bionic Hydrant Wrench,  
Nikon Coolpix S1000pj,  
Palm Pre, Quikrete Green  
Concrete Mix, Lehr  
Propane Eco Trimmer



Cameron, Venter, Kamen and Musk sit on the X Prize board of trustees.



A close-up, three-quarter profile portrait of a middle-aged man with dark hair, a light beard, and thin-rimmed glasses. He is looking slightly off-camera to the right. He is wearing a dark suit jacket over a light-colored, button-down shirt. The background is a soft, out-of-focus greenish-grey.

The influenza scientist,  
photographed in  
Madison, Wisconsin,  
on 27 August 2014.



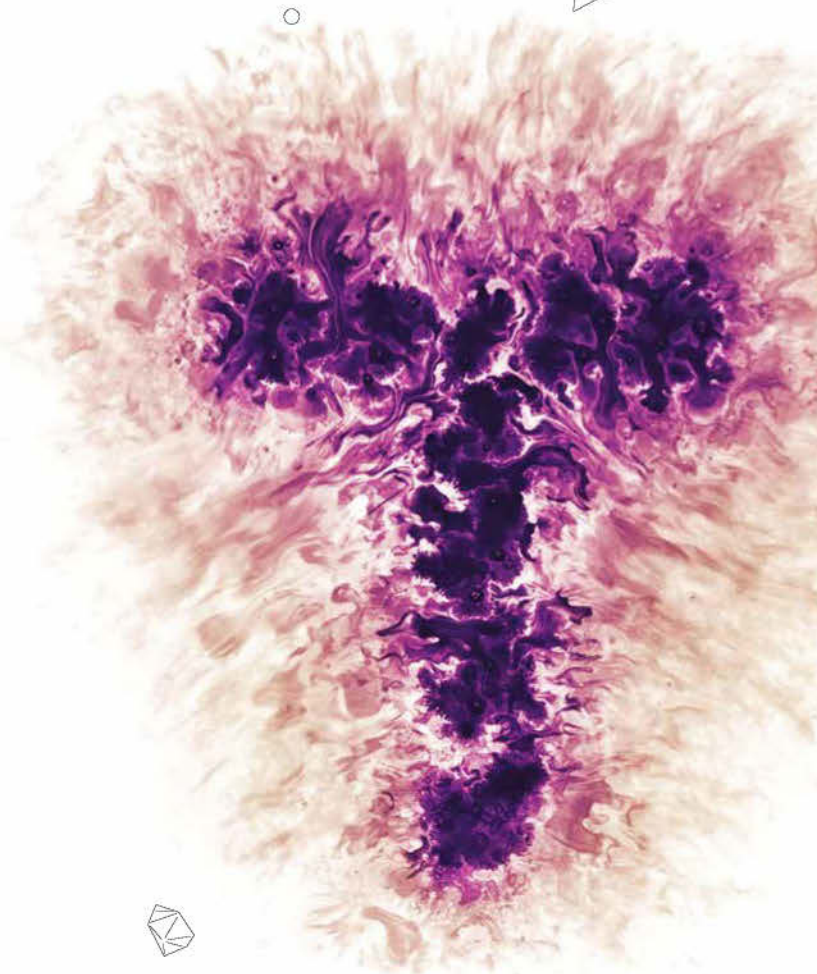


YOSHIHIRO KAWAOKA  
CAUSED A GLOBAL  
UPROAR BY RE-CREATING  
THE FLU VIRUS THAT  
A CENTURY AGO KILLED  
MORE THAN 40 MILLION  
PEOPLE. THAT MIGHT  
SOUND CRAZY, BUT  
WHEN A REAL INFLUENZA  
PANDEMIC STRIKES,  
YOU'RE GOING TO WANT  
HIM ON YOUR SIDE.

## THE MAN WHO COULD DESTROY THE WORLD

By MIKE MAGNUSON  
PHOTOGRAPH By SASHA NIALLA

10TH  
ANNIVERSARY  
BREAKTHROUGH  
AWARDS



**THE VIRUS SITS IN 2-MILLILITRE VIALS** inside a freezer kept at minus 80 degrees. At that temperature, in that deep of a deep freeze, the virus is preserved as if in amber, lying in wait. Under a microscope it looks something like a mediaeval battle weapon, a spherical object stabbed with dozens of little spikes, like the actual virus it was engineered to replicate: the 1918 strain of H1N1, otherwise known as the Spanish flu, a pandemic estimated to have killed more than 40 million people.

The freezer is locked and sealed inside a room made of concrete walls set within a lab surrounded by another set of walls – those outer walls made of 45 centimetres of concrete reinforced by steel rebar. A box within a box, as it's known in the research world. Entry is through a series of rooms starting with air-locked, submarine-type doors, and the place is rigged with extensive alarms – more than 500 of them in all, spread throughout the building and attached to various pieces of equipment, ready to alert safety personnel and the campus police who monitor the facility around the clock if someone who doesn't belong there tries to get in.

The freezers, the air-locked doors, the alarms – they must all operate perfectly, because perfection is the minimum requirement at the R140-million Influenza Research Institute. The facility sits on the outskirts of the University of Wisconsin-Madison.

Assuming they pass the FBI background check necessary even for the administrative assistants who work there, employees entering the lab are required to remove all their street clothes, including undergarments. Once they put on dedicated scrubs, with shoe covers both inside and outside a pair of dedicated garden clogs, they access an anteroom outside the lab. To go into the laboratory, they need a different pair of clogs and shoe covers specific to that space, and must pull on a Tyvek jumpsuit, a hooded respirator outfitted with an air filter, and two pairs of disposable Tyvek gloves. Upon leaving, they take all that off in a specific order, then take a 5-minute shower with soap and water during which they are required to wash all orifices and blow their noses.

The suite that houses the virus is a BSL-3-Ag facility – essentially the most secure building of its kind in existence, give or take one or two features. (The building also houses research on the Ebola virus.) Not one particle of anything is allowed to escape.

The institute was built in 2008 largely to advance the efforts of one man, Yoshihiro Kawaoka, a professor of virology who several months ago published a study detailing his successful bid to build the virus – a strain of influenza that's almost identical to the Spanish flu – from contemporary flu genes. For the study he infected ferrets with the virus and mutated the strain to make it more easily transmissible through respiratory droplets – in other words, from sneezing mammal to sneezing mammal.

In another freezer in another part of the building sits an H5N1 virus that includes genes from the swine flu that killed nearly half a million people in 2009. Kawaoka published his work on that one in 2012. And in yet another deep-freeze storage unit resides another version of that 2009 pandemic strain – one that, according to a published report based on information leaked from a closed-door scientific meeting, is designed to elude human immunities as easily as water flows around rocks.

Why would he do that, even in an impermeable fortress such as that one? At first Kawaoka declined to explain why for this story. Eventually he agreed to meet for 1 hour, in a conference room near the front door of his lab, in the presence of his university department chair. Kawaoka and his minder seemed uncomfortable as the meeting began. The department head smiled with a little too much enthusiasm and seemed to have an itch under his white beard that he didn't want to scratch. Kawaoka rubbed his hands together and stared at a closed laptop as if it were a friend to whom he wanted to tell a secret. He looked as if he were waiting for the question he knew would be asked, the one everyone asks when they hear what he has done, the question even some of his colleagues at the highest levels of the scientific community have asked publicly.

Is Yoshihiro Kawaoka crazy?

**OUTSIDE THE CONCENTRIC, SECURE RINGS** of his research facility, and outside the comforts of Madison – the university, and officials in the state of Wisconsin itself, have been unwavering in their support of Kawaoka, to the point of constructing the R140 million building in order to fight off other suitors – that question has been debated by hordes of people with varying degrees of credibility.

His study of the H5N1 virus, because it detailed so precisely his methods for rebuilding the virus, was so controversial that a National Institutes of Health advisory panel recommended parts of the research be kept from the public when it was scheduled to appear in 2012 in the journal *Nature*.



In June Kawaoka and his team published the results of the 1918-like virus study in the journal *Cell Host & Microbe*, and on the day of publication, before most people had had a chance to read the results, *The Guardian* ran a story under the headline "Scientists Condemn 'Crazy, Dangerous' Creation of Deadly Airborne Flu Virus". The article referred to the virus as "life-threatening" and quoted Lord May, former chief scientific adviser to the British government, as saying Kawaoka's work was "absolutely crazy". Simon Wain-Hobson, of the esteemed Institut Pasteur in France, told the newspaper, "It's madness."

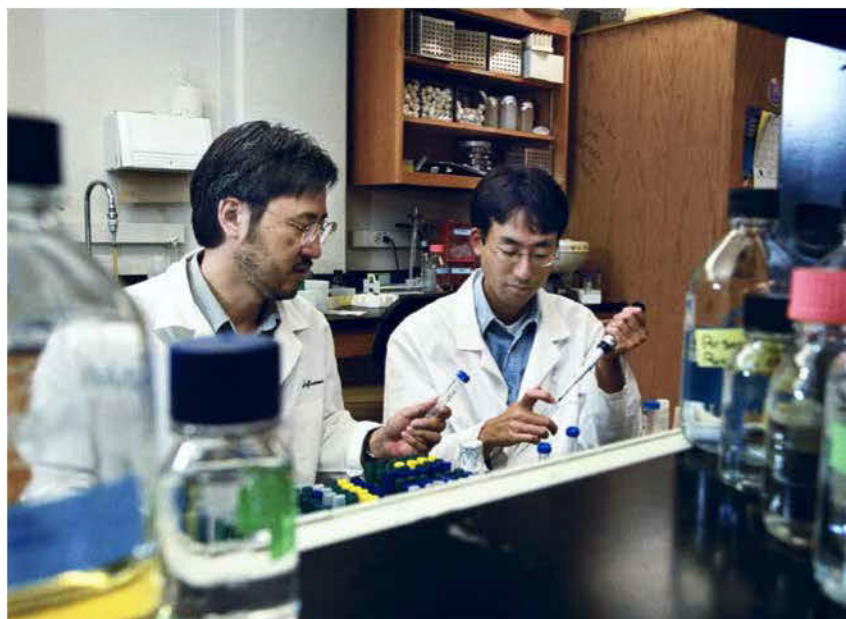
The scientists who object believe Kawaoka's work violates the Nuremberg Code's rules for research with biological agents, and argue that engineering non-natural biological pathogens creates the potential for a laboratory accident that would release them and in turn cause a calamity. They believe the risk of the research represents such a danger that it must be stopped.

In July *The Independent* ran a piece based on a report from a closed-door meeting contending that Kawaoka had engineered a new influenza virus, one that would "render the human immune system defenceless" were it to escape from his lab in Madison. A day later Gizmodo tweeted a link to a recap of the article, with this heading: "Scientist creates new flu virus that can kill all of humanity".

Tweets such as that one, linked to a damning article, combined to make Kawaoka's work on viruses to go viral. Before long, tweets and blog posts and all other forms of electronic outrage spread far and wide through communities who have as much scientific knowledge as chickens do. One tweeter opined that Kawaoka "should be locked in a padded cell". He occasionally receives threats in his email, that if he doesn't stop his work, etcetera. He forwards these to the FBI and tries not to think about them. He tries to think only about work.

There is, after all, no logical end point to what he does. All around us there is influenza, everywhere, in many forms. Waterfowl carry the virus, ducks especially, and more often than not they do not present symptoms, even though they shed the virus at a nearly constant rate, mostly through their intestinal tracts, which is to say when an infected duck shits in a pond, it is depositing influenza into the pond. Because waterfowl exist wherever there is water, they not only spread the flu everywhere but they facilitate the mutation of milder forms of flu into dangerous iterations.

Here is one way this might occur: say an H5N3-infected blue-winged teal, which has the rather apt scientific name *Anas discors*, heads down the Mississippi Flyway from Madison to Arkansas and lands in a pond to rest and defecate in the pond. Then a pig wallows at the shore and becomes infected with H5N3 and comes down with some preliminary symptoms – runny nose, cough, mild fever. Soon after, a mallard infected with H1N1 arrives on the Mississippi Flyway from central Missouri and lands on and defecates in the same pond, and the unfortunate H5N3-infected pig returns and now becomes infected with the Missouri duck's strain of flu. If a number of conditions come together at that moment inside that pig, the rare event may occur when two forms of virus combine into one – a new virus for which no mammal has developed immunity. If this novel strain of influenza



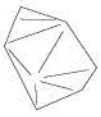
**Top:** Kawaoka (left) works with a post-doctoral research associate in this 2001 photograph taken before the campus's present-day research lab was built. The new facility closes once a year for a four- to six-week-long decontamination process.  
**Above:** Colorised transmission electron micrograph of Avian influenza A H5N1 viruses (seen in gold) grown in MDCK cells (seen in green).

**BREAKTHROUGH**  
WHO  
Yoshihiro Kawaoka  
University of  
Wisconsin-Madison  
**FIELD**  
Virology  
**ACHIEVEMENT**  
Flu pandemic  
prevention  
research.

can be transmitted through the air from creature to creature, that's when people start using the word pandemic.

Scientists around the world are pursuing various strategies for dealing with this sort of scenario – with beating back a pandemic should one break out, or preventing one in the first place. But influenza has always been present on Earth, even though the virus itself was not isolated until 1902. The flu needs only cells to flourish. A protein in the flu known as hemagglutinin forms a head-like structure that attaches to a cell and essentially breaks through the walls. The virus then infects the cell, uses the cell's machinery to make copies of itself, and kills it. Often the infection remains in the upper respiratory system, which is the kind of influenza we call the seasonal flu, but on rare occasions, owing to the virus's ability to mutate, it will find a way to defeat the defenses holding it back. Consequently, this new, mutated strain will become more virulent and move from the upper respiratory system to multiple organs and have a strong chance of killing its host and spreading rapidly to other hosts.

Influenza infects many animal species naturally – chickens, pigs, horses, and dogs, in addition to waterfowl. In com-



mercial chicken farming, for example, influenza can wipe out millions of birds at a time and in turn cost economies millions, so for financial stability alone, the flu must be controlled. Since many of the same strains of influenza that appear in animals also infect humans, and some are transmissible between species, veterinary researchers are the front line of defense against the disease.

**KAWAOKA IS A VETERINARY RESEARCHER.** He has been fascinated with such things since he was a university student in Japan who wanted to know the inner workings of animals – the muscles, the bones, the blood, the cells – and majored in veterinary medicine. After graduate school and many experiments and papers, he had become an accomplished research veterinarian with a rising reputation in his field. Then he went to the United States to work at the world-renowned St Jude Children's Research Hospital in Memphis, Tennessee, where he stayed for 14 years, until he had the good fortune, he says, to join the faculty of the University of Wisconsin-Madison, where he's been a professor in the School of Veterinary Medicine since 1997. Kawaoka also holds a professorship at the University of Tokyo, where he spends between two and three months a year, and he regularly gives presentations of his research all over the world.

In 2006, he won the Robert Koch Award, which, in the world of microbiology, is akin to the Nobel. Everyone in the field knows of him and of his work, and the demands upon him, from both the scientific community and the scientific press, are relentless. Kawaoka says he has worked all day, seven days a week, since his last holiday, which was so long ago he no longer recalls what year it was.

He's 58 years old, but he somehow looks not a day older than 35 – lean, no bags under the eyes – and he smiles a lot and has a warm laugh. He's been married for a long time and has a 33-year-old son who lives on the West Coast. His commute is a 15-minute drive in a Toyota, during which he likes to listen to female jazz vocalists. When he parks in front of his lab each morning, before he gathers his briefcase and heads in, he sometimes pauses to note the fine weather or to watch birds flying overhead. He may think more thoughts than the average person during the course of his day, but he keeps most of them to himself.

As the interview progresses, Kawaoka begins to lean into the conversation, to become more animated. He has an appealing self-deprecating streak. If you ask him if it's miraculous that he can engineer new viruses, he throws up his hands and chuckles and says, "Well, my sister couldn't do it." Any scientist with the proper training, he says, can pursue the same research. Despite the long hours, despite the controversies, he says he loves his work, and the main reason is that it's fun. And what's fun, he says, is learning new things. Relentless inquiry, for him, is the greatest joy in the world. He shrugs as if to say, what else could you want out of life? Instead, he says, "When my work is no longer fun, I will quit."

Which still doesn't get to the heart of the question about re-creating the 1918 flu: Why?

**HERE IS ONE THING** most of the general public doesn't understand: there is no way to defeat the flu. Kawaoka shakes his head. It can never be eradicated from the Earth.

What if you kill all the ducks?

He lets out a laugh at the thought of that. He extends his arms to the universe and says, "There are too many of them!"

One realistic way to stop the flu from at some point turning into a pandemic, in Kawaoka's opinion, would be to stop the transmission of influenza from birds and other animals to humans, and in order to do that, he believes he must continue with his specific type of work, which is called gain-of-function research. Remember how the flu can mutate in nature – the unfortunate pig? Kawaoka imitates this phenomenon in his lab. He manipulates viruses – or mutates them – to study them. By doing that, he says we can learn how to react when a new virus occurs by mutation in Nature – a virus such as the Spanish flu. If we know how a mutation works – if we have observed it and catalogued its behaviour – then we can assess whether existing countermeasures such as vaccines and antiviral drugs are effective in combating it.

If we know that they are, then we can create a stockpile. Through this process, his research aims to save lives.

So far, ferrets and mice constitute the only casualties of Kawaoka's research (ferrets are considered to be the best animal for virus testing because they react to the flu in much

## RECONSTRUCTING A KILLER

An oversimplified look at how Kawaoka re-created the 1918 Spanish flu.  
By KEVIN DUPZYK



1

### STEP 1: REVERSE-ENGINEER THE NEARLY 100-YEAR-OLD VIRUS.

For each gene of the 1918 virus, Kawaoka found a modern version – from various bird viruses – that produced a near-identical protein. Then he assembled their gene sequences, resulting in a patchwork strain genetically similar to the one from 1918, whose genome was reconstructed in 2005.

2

### STEP 2: MAKE SURE IT WORKS.

Namely, that it causes an infection. The manufactured virus didn't get ferrets as sick as the real 1918 flu did, but it provoked more severe symptoms than a seasonal virus used as a control.

3

### STEP 3: FIND OUT WHAT ALLOWS THE VIRUS TO SPREAD.

A pandemic happens only when a virus is highly communicable. He put infected ferrets in cages next to healthy ones, but his engineered flu didn't spread. He swapped gene sequences from the 1918 flu into his strain until he determined which were key to spreading infection.

4

### STEP 4: MUTATE THE CRUCIAL GENES.

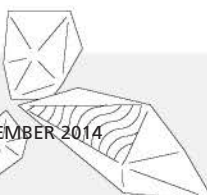
In Nature a scientist obviously isn't manu-

ally swapping gene sequences. Kawaoka needed to see how his engineered virus would behave if it had known mutations thought to be necessary for bird viruses to spread in mammals. He created different combinations of these mutations and infected ferrets again.

5

### STEP 5: REPEAT AS NEEDED.

One set of ferrets showed symptoms more similar to those of the real 1918 flu. It turned out the virus had gained additional mutations. He repeated the ferret experiment. Again the virus mutated. In all he attained 10 mutations. Next step: watch to see if a similar virus appears in Nature.





the same way humans do). To test the virulence of a given mutated flu, Kawaoka infects those species, but the animals do not pass from this world in vain. Kawaoka's controversial studies have shown that the lab-generated mutations are treatable with the antiviral drug oseltamivir, otherwise known as Tamiflu, which suggests that the dangerous viruses in his lab are not as dangerous as they sound.

Indeed, it turns out that after a virulent new flu spreads, after all the misery it may cause, humans develop resistance to it. The 2009 swine flu? That now circulates as a seasonal malady, and if the 1918 virus were to return, even in Kawaoka's re-created form, we would have nearly complete immunity to it. You could probably spread that form of the flu on toast with no ill effect. This is difficult to believe, given the angst over his work, but when pressed Kawaoka becomes more animated than at any point in the interview, shaking his head like a dog shaking off water. Even the supposed wipe-out-the-world virus – from the article in *The Independent* – was completely misunderstood, which resulted in a story that was “thoroughly inaccurate”, says the university's biosafety manager, Rebecca Moritz.

You may wonder why he doesn't simply say as much when he's under seige. But if he uses that defence – See? It's harmless! – rather than making a case for the work's importance, he would have no way to argue for research with viruses that truly are hazardous.



**HOW DOES IT FEEL TO BE THE TARGET** of harsh criticism, some of it obviously ill-informed, as he was recently? Some of Kawaoka's brightness peels away, and he slumps forward. Then he looks up.



“It makes me sad,” Kawaoka says.

He explains. It's not because the attacks hurt his feelings or make him feel threatened. He says he just wishes his critics understood that he is doing his research in order to try to help protect humanity, not to wipe it out. This is partly where he finds the fortitude to press on – the hope that one of his discoveries could save untold lives. He never contemplates giving up on the complicated, sometimes dangerous, and essential work of understanding what could happen in nature and trying to get ahead of it.

He acknowledges that his work is risky, that there is no such thing as zero risk, but if the forecast calls for a 10 per cent chance of rain, we don't carry an umbrella. True, the stakes are much higher with hazardous viruses, and he understands the fear with his work: what if he engineers a virus for which existing medications don't work? That is a risk, in his opinion, worth taking. Kawaoka, who is now also conducting studies on the Ebola virus, insists he practises great caution and agrees with the safety regulations for his lab – even though, he says, the people working there are more likely to get the flu from their children than at work. “You are at much more risk of catching the flu,” he says, “if you go to the park and feed the ducks.”

**ON THE DAY HE SAYS THIS**, the weather in Madison is as perfect as a person could imagine: sunny, small cumulus clouds dotting a blue sky, low humidity, temperatures drifting toward the 20s, and a gentle breeze. Just down the road, in the Teal Pond Wetlands at the university's arboretum, ducks and geese land in the marshes or take wing and travel along the flyway that extends from the Mississippi River to lakes Monona and Mendota, the two large lakes in Madison, and to the isthmus in between where 43 000 students study, work, live and play.

On the campus's Memorial Union Terrace, a few hundred people – undergrads, families with children, some professor types – have gathered to relax in the famous steel sunburst chairs and take in the view of Lake Mendota. They drink beer and eat bratwurst and seem uniformly content. Sailboats dot the water. Closer to shore, a few students try paddleboarding. Just now this seems like one of the loveliest places in the world.

Next to the pier, there is a sign in the water: for swimmer health, do not feed the ducks. Four juvenile mallards swim in frenzied circles nearby, scrabbling for a bratwurst bun some idiot has chucked into the water. The ducks jostle and quack and snap till the bun becomes what looks like white stars in a greenish-blue firmament, then all traces of it vanish and the mallards settle down. One hops on to the pier and defecates on it.

A couple of teenage girls in swimsuits approach the pier in bare feet, laughing and talking about paddleboarding, and they scare off the mallard. One of the girls steps on the fresh duck poop, but she doesn't notice. She's going to hop on a paddleboard for the afternoon. Six kilometres away, in a place she'll probably never know or see, a freezer hums steadily in the dim light, protecting the work of a scientist who cares only about keeping her safe.

**PM**



# Mobility re-imagined

TECHNOLOGIES AND SOCIETY ARE CONVERGING LIKE NEVER BEFORE, GIVING RISE TO ENTIRELY NEW PARADIGMS FOR MOBILITY QUITE UNLIKE ANYTHING WE'VE COME TO KNOW.

**I**t's no longer surprising when a First World metropolis such as Paris takes the drastic step of banning cars altogether from its city centre because of smog. That is just another example of how we are starting to see the impact on our climate of over 120 years of industrialised endeavour.

To succeed in this environment, motor manufacturers are obliged to wholeheartedly embrace forward-looking technologies, yet be acutely sensitive to their potential impacts. It's the kind of thinking that underpins BMW's innovative i division.

Fittingly, *POPULAR MECHANICS'* FutureTech 2014 featured the first fruits of BMW i, the all-electric BMW i3. The sleek, futuristic i3 hatchbacks swished back and forth,

conveying delegates and guests between the parking and the conference venue at the SA Sports Science Institute. Although distinctly cutting-edge, these carbon-fibre-bodied marvels caught the eye with stylish looks and spacious interiors, comfortably blending a modern drivetrain and finishes with the familiar feel of traditional materials.

But it's about a lot more than just getting from A to B, BMW engineer Deena Govender told PM FutureTech delegates. "As much as the BMW Group is reacting to mobility paradigms and changes in our society, as one of the leading companies in personal mobility and services we are also trying to help shape the future in a positive way." Sustainable personal



**BMW's Deena Govender: We have to make it easy.**

mobility is the goal: what they like to think of as automobility.

To meet challenges such as urbanisation and environmental problems – noticeable, even in developing countries – BMW i has chosen to follow a path that emphasises electrical mobility. But that will entail more than merely developing electric vehicles: it means having to encourage the rest of us.

"Because of the convergence of technologies and also with the challenges we have, we need to make the adoption of electrical mobility technologies as easy as



possible,” Govender said. The setting up of infrastructure – recharging stations – is an immediate physical issue. Even before that, getting State buy-in is critical to the success of an EV programme and the big industry players are collaborating on solutions, including protocols for recharging stations.

Connectivity is also an important part of tomorrow’s smart mobility. With smart recharge strategies, managed via the Web through apps, we could at a stroke consign one irritating feature to history: the queue at the petrol pumps. By means of interactive apps using a mobile device, the user is able to gain access to his i3’s status screen. “You can check if your car is charged and what its range is.”

Probably the coolest feature, Govender believes, is range overlaid on a map. “Because the car is permanently connected to the Internet, you are able to use real-time traffic information (RTTI) and also the route’s navigation profile. It can use elevation as well as distance (spatial co-ordination) to know that you are going to be able to get 90 km in one direction, but maybe 120 km in another.” This system, still being refined, will provide a “range spider” overlay on actual roads instead of a simplistic circle showing maximum range radius.

He points out that the connection to the car is not a simple peer-to-peer one and has multiple security layers. “Your mobile device is not talking directly to the car. It goes via a server and firewalls in Germany and it’s amazing how quickly this goes.”

All of this, necessarily has to be quite seamless to the end user. One somewhat endearing solution to this in the BMW i approach (and it’s one that other “Eco” programmes have adopted to an extent) is that it taps into human nature: our competitive instinct.

“From an efficiency point of view we know one way of driving consumer behaviour is to gamify things. If you introduce a competition, people change their behaviour. So for example, just in terms of statistics, (BMW i allows you to) compare your driving behaviour in terms of parameters such as your efficiency, or energy recovered by recuperation on the car, with your community. In addition to this there are a whole host of other measures to make you start thinking about how you use energy.”

BMW i stands for a new form of future urban mobility, for visionary vehicles and mobility services. As social, economic and ecological change happens around the world, new solutions with a special urban focus are needed. Electric mobility is an essential component in this transformation – and BMW i is turning a vision into reality.

## BMW i3

### No compromise

The BMW Group’s first volume-produced model driven purely by electric power combines visionary design with a carbon-fibre shell and revolutionary vehicle architecture, yet retains the driving pleasure we’ve come to expect from BMW.

Although the i3 is a premium product, it is strongly defined by sustainability. Consider this: the BMW i3’s carbon footprint is around a third smaller than that of the BMW 118d – the World Green Car of the Year 2008 – or around 50 per cent smaller if the car is running on power generated from renewable sources.

The sustainability concept runs across the entire value chain, including carbon-fibre production using 100 per cent renewable energy. BMW eDrive technology combines an electric motor and high-performance lithium-ion battery developed and manufactured independently by the BMW Group.



### i3: FAST FACTS

|                             |                    |
|-----------------------------|--------------------|
| <b>MAXIMUM POWER</b>        | 125 kW             |
| <b>MAXIMUM TORQUE</b>       | 250 N.m            |
| <b>ENERGY CAPACITY</b>      | 18,8 kWh           |
| <b>BOOT</b>                 | 260 – 1 100 litres |
| <b>PERFORMANCE</b>          |                    |
| 0-100 km/h                  | 7,2 s              |
| 80 – 120 km/h               | 4,9 s              |
| <b>TOP SPEED</b>            | 150 km/h           |
| <b>ENERGY CONSUMPTION</b>   | 12,9 kWh/100 km    |
| <b>RANGE (Comfort mode)</b> | up to 160 km       |

## BMW i8

### Visionary

Like its i3 stablemate, the plug-in hybrid i8 is the product of an all-embracing sustainability concept, from production to recycling.

The i8’s plug-in hybrid system, developed and produced by the BMW Group, represents the latest development stage of BMW EfficientDynamics. The i8 also marks the debut of a three-cylinder 1,5-litre petrol engine with BMW TwinPower Turbo technology. Drive is sent to the rear wheels via a six-speed automatic transmission and to the front via a two-stage automatic ‘box. The i8’s combination of BMW TwinPower Turbo and BMW eDrive technology plus intelligent energy management produces the performance characteristics of a thoroughbred sports car.

A carbon-fibre passenger cell and aluminium drive module are keys to the i8’s kerb weight of just 1 490 kilograms, very low centre of gravity (below 460 millimetres) and well-balanced weight distribution.



### i8: FAST FACTS

|                              |                   |
|------------------------------|-------------------|
| <b>SYSTEM MAX POWER</b>      | 266 kW            |
| <b>SYSTEM MAX TORQUE</b>     | 570 N.m           |
| <b>IC ENGINE POWER</b>       | 170 kW            |
| <b>IC ENGINE TORQUE</b>      | 320 N.m           |
| <b>ELECTRIC MOTOR POWER</b>  | 96 kW             |
| <b>ELECTRIC MOTOR TORQUE</b> | 250 N.m           |
| <b>BATTERY CAPACITY</b>      | 5 kWh             |
| <b>ECONOMY</b>               | 2,1 litres/100 km |
| <b>PERFORMANCE</b>           |                   |
| 0-100 km/h                   | 4,4 s             |
| Top speed                    | 250 km/h          |
| <b>EV RANGE</b>              | up to 37 km       |
| <b>COMBINED RANGE</b>        | 440 km            |

# A BEAUTIFUL THING

The American Felling Axe



Local versions of this classic axe can be found at specialist hardware stores, home centres and importers, ranging from the Lasher at around R350 to the Swedish Gränsfors at nearly R2 000.

PHOTOGRAPH BY PHILIP FRIEDMAN



220

kilograms per square metre: density of the Appalachian hickory handles, the highest quality available

70

different designs Best Made has painted on the ends of its axe handles

06

weeks between the forging of the axe head and the felling of a tree

**THE SATISFACTION KICKS IN** midswing, before you actually strike wood. As the axe skies up over your head, the power from your hoist begins to give way to the momentum of the tool. Man and axe seem to conjoin, just for a moment. Your hand slides down the length of the handle and settles on the smooth grip of the varnished end. Work is about to get done.

The axe, a little under 2 kilograms of capability modelled after the pieces that settled the American West, got its start in Peter Buchanan-Smith's garage in New Jersey, where he founded Best Made Company five years ago. He had been working as a graphic designer,

doing the artwork for a new edition of Strunk and White's *The Elements of Style* and for *Paper* magazine, but he was also an outdoorsman who was searching for an axe of the quality he grew up with on his family's farm in Ontario, Canada.

Enlisting a fourth-generation, family-run tool manufacturer in North Carolina and its two-storey drop forge, Best Made smiths the axe head out of 5160 steel, the same strong yet flexible alloy used for the spring suspension in trucks in the 1940s. The bit is thinner than on modern axes, sharper and more efficient, and gleams with the minimal finish it gets at the forge. It acts as

proof that mistakes weren't made during the process; there isn't any extra finishing trying to cover them up.

The heads are affixed to Appalachian hickory handles in a Maryland workshop. Then the handles get primed, sealed, spray-painted, and finished with marine-grade varnish. The 70 different designs Best Made has painted on its axes over the years is partly born of Buchanan-Smith's background as an artist. But the personalisation recalls a tradition both simpler and more grand, of a man and his one-of-a-kind axe getting the hell outside and working together. — MATT GOULET

• **COMPANY:**  
Best Made Co.  
([bestmadeco.com](http://bestmadeco.com))

• **FOUNDED BY:**  
Peter Buchanan-Smith

• **LOCATION:**  
New York, New York





## ALL ABUZZ ABOUT BEES

What do a cyberguitarist, beekeepers, dark matter and the most ambitious salvage operation in history have in common? That's right: #PMFutureTech2014

**FIRST, THE INCREASINGLY AWED SILENCE** that, translated, indicates the sound of jaws dropping. Smiles. And then, spontaneous applause. It was like that, listening to the story pour out of Greg Aberdeen.

And what a story it is. An unlikely – miraculous, almost – tale of a home-grown beekeeping innovation that is taking the world by storm. To think it all started out with the idea of generating some extra employment for a hearing-impaired workforce. After their story appeared in *POPULAR MECHANICS*, that workforce has had to be trebled. And re-trebled.

Fittingly, PM awarded its prestigious **Inventor of the Year** title to Mark Collins and Aberdeen for the development of this revolutionary beehive system. Their BeePak composite flat-pack design, an all-South African concept featured in PM August 2014, solves some of the most critical problems in modern beekeeping.

In a citation accompanying the award, made at *POPULAR MECHANICS FutureTech 2014* in Cape Town, the two inventors were praised for their "inspiration, technological prowess and entrepreneurial spirit". At the same function, two University of Cape Town bio-engineers, Dr George Vicatos and MSc student Severin Tenim, were honoured with the **Cutting Edge** award for the design and development of an affordable anthropomorphic (human-like) prosthetic hand. Three years ago, Dr Vicatos

claimed the top spot for inventing a versatile and potentially life-changing facial reconstruction system.

PM also presented deserving players in the industry with **Breakthrough Awards**: the **Science Award** was handed over to the University of Stellenbosch for the recent nanochip on a capsule breakthrough; BMW accepted the **Automotive Mobility Award** for its innovative mobility technology.

The announcements came at the end of a varied and exciting programme described by one impressed delegate as "insane, but wonderful". Keynote presenter was *Costa Concordia* salvor Captain Nick Sloane, who delivered an illustrated talk on the biggest salvage operation in maritime history.

Looking to the future, in a wide-ranging overview of the design process, Imraan Lambat – who heads the technical division for manufacturing and process plant verticals at FutureTech headline sponsors WorldsView Technologies in Africa, representing multinational 3D CAD software company Autodesk – provided delegates with penetrating insights into the innovative ways in which our world is being shaped. Similarly, Deena Govender, from FutureTech associate BMW, lifted the lid on the company's vision of the mobility of tomorrow – some of it available right now.

Making his valedictory appearance, outgoing PM Editor Alan Duggan – for so long the driving force behind FutureTech and its precursors – gazed into his crystal ball for some 2020 predictions. In typically waggish mood (then again, he might have been entirely serious) he concluded by saying, "I am looking forward to the





Keynote speaker Captain Nick Sloane (opposite, left) recounted the gripping tale of the raising of the *Costa Concordia*. Cyberguitarist Jonathan Crossley (opposite, right), likewise kept the audience (above) enthralled. Right, Greg Aberdeen (left) and Mark Collins show off their awards. Bottom, headline sponsors WorldsView Technologies and Autodesk captured the imagination of delegates at their foyer display with insights into the technologies now shaping our world.

day I can merge with a machine and become superhuman."

Also in the spotlight were cyber-guitarist Jonathan Crossley, a formidably accomplished musician and doctoral student from Wits University who played a weird guitar and waxed lyrical on "ordered noise"; and Stellenbosch University history professor Sandra Swart, who spoke about "Zombie zoology" (actually, a commentary on attempts to revive extinct species).

Delegates also heard about dark energy candidates from Professor Peter Dunsby, co-director of the Centre for Astrophysics, Cosmology and Gravitation at UCT; took a sneak peek at future technology on our seas with Nautic CEO James Fisher; learnt about modern photonics from the CSIR's Professor Andrew Forbes; and were blown away by a talented musician who goes by the name Wild Lettuce.

Said PM Editor Anthony Doman: "I'll admit I was a little concerned about whether dark matter and biomechanics could coexist with amplified guitars – not to mention didgeridoos. But I'm pleased to report that, not only do they coexist, they even at times draw on each other's DNA to create an altogether new, exciting hybrid.

"In fact, that description pretty much encapsulates FutureTech. Under the stewardship of my predecessor, Alan Duggan, this unique event has steadily grown in stature. And I'm truly excited by its potential. Curiosity is hardwired into humankind; FutureTech celebrates that enquiring mind. It informs, challenges and inspires, reflecting our maxim, 'Be the first to know'. Above all, like POPULAR MECHANICS, it accomplishes this in a thoroughly engaging, compelling way."

PM



# UPGRADE



## FORMOSA AMPHIBIOUS HOUSE HOME AND DRY

Living near flood-prone areas tends to mean that, once in a while, you get your feet wet. (If it's a really bad year, your hair, too.)

UK firm Baca Architects' ingenious solution is Formosa, an amphibious house. When the floods come, the house rises up in its dock and floats there, buoyed by the floodwater. When the waters recede, it settles gently back on its foundations.

Built on the banks of the UK's River Thames in the picturesque stretch that passes through Marlow, in Buckinghamshire, the unique 225 m<sup>2</sup> dwelling is located just 10 metres from the water's edge. It replaces a dilapidated bungalow. The new house has been designed to cope with up to 2,5 metres of floodwater, well above the predicted flood levels and future projected flood levels for the area.

Baca Architects describe themselves as specialists in waterfront architecture and flood-resilient aquitecture, with considerable experience in the UK, Netherlands and USA. Says structural engineer Matthew Wells: "The house is designed as a free-floating pontoon. A light-weight superstructure is supported on a concrete base with sufficient ballast to ensure stability and adequate freeboard. The floating house is secured by four dolphins – permanent vertical posts – arranged close up to the sidewalls. The assembly is sited within a wet dock comprising retaining walls and base slab. When flooding occurs the dock fills with water and the house rises accordingly."

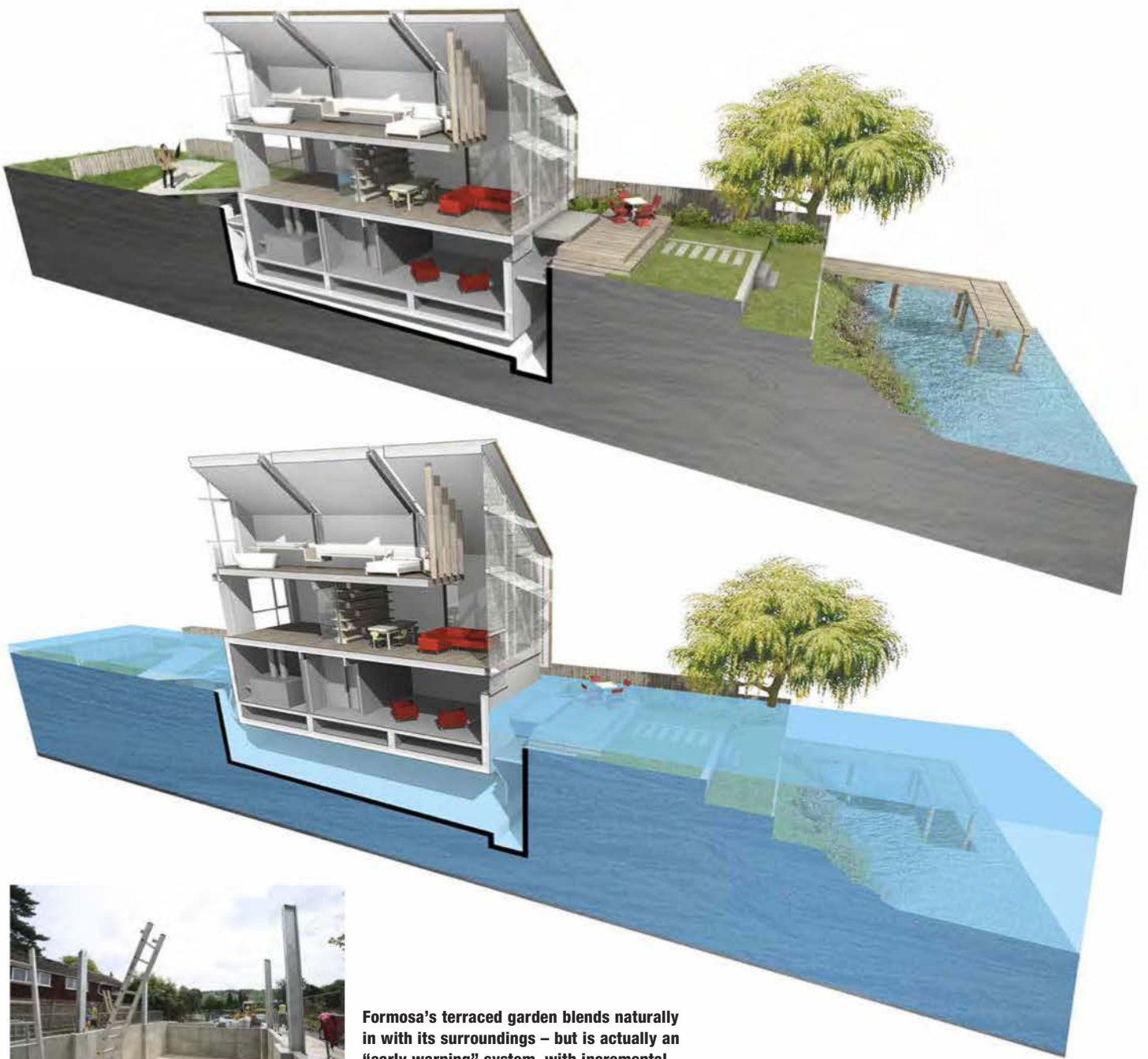
Although Formosa is high-tech and "green" – it is a highly insulated, low-energy building, with water-saving and energy-saving devices – it is also designed to neatly fit in with its surroundings. A carefully laid out garden acts as a natural early warning flood system, with terraces set at different levels designed to flood incrementally to alert the occupants. The lowest terrace is planted with reeds, the next with shrubs and plants, then a lawn and the highest step is a patio with direct access into the open-plan living space. Post-flooding, the demarcated levels also help to manage run-off from the house as flood waters begin to subside as well as reducing siltation of the dock.

Building an amphibious home currently costs around 20 per cent to 25 per cent more than a similar-sized house; with construction costs predicted to fall as builders and manufacturers get to grips with the much wetter weather phenomenon and embrace new thinking and technology.

Source: Baca Architects







**Formosa's terraced garden blends naturally in with its surroundings – but is actually an “early warning” system, with incremental flooding warning occupants until extreme floods cause the house to float in its own dock.**





## MASS FIDELITY CORE 2 CAN GO INTO 1

There's considerable debate about what constitutes the most significant breakthrough in audio history. Digital is a prime contender, of course, as are surround sound, the vacuum tube and its modern equivalent, the transistor. Many would argue, though, that the most notable of them all is stereo. Almost overnight, stereo rendered the single-speaker mono standard obsolete. In the quest for a realistic soundstage, nothing less than a two-speaker system would do, it seemed – for the next half a century, until surround sound signalled the next phase in the speaker Arms Race.

But what do you know: Canadian company Mass Fidelity has found a way to make 2 go into 1. Its Core wireless speaker is said to create what its designers call a kind of sonic hologram from a single, portable Bluetooth-connected sound source. Stereo, if you will, from mono.

How it does that isn't made clear, but five years of development lie behind the Core. Mass Fidelity was able to call on its formidable expertise in digital sound, evidenced by its relay Bluetooth DAC. Inside the Core's compact 15 x 15 x 10 cm enclosure are 6 24-bit digital signal processors as well as an ARM-based processor.

Mass Fidelity CEO Ben Webster says that what makes the Core truly revolutionary is the use of innovative Wave Field Synthesis technology. "Wave Field

Synthesis is an entirely new way of rendering audio where a sound image is produced by recreating that sound in space – similar to a hologram. This astonishing sound image can be 'viewed' from anywhere in the room. It is purer and sounds better than traditional stereo, because it does not rely on the listener's position or on 'tricking the brain' with psychoacoustics."

The Core is no mere smartphone add-on, either. Power output is a healthy 120 watts via a total of six drivers covering the entire audio spectrum. Although a woofer is built in, an external sub-woofer can be connected. Besides being used for music, the Core has a built-in microphone to enable its use as a speakerphone when connected to a mobile. It can link to as many as nine devices over its own network, too. Other connectivity options include USB, conventional analogue and digital inputs and a control input for home automation.

The company appears to have generated sufficient interest for its Indiegogo crowdfunding initiative to be comfortably oversubscribed. Expected retail price is about R6 000, with initial delivery around March 2015.

Local distributor is the SD Group ([www.sdgroup.co.za](http://www.sdgroup.co.za), email [info@sdgroup.co.za](mailto:info@sdgroup.co.za), 021 300 1300).





Brings every image to life.  
*That's why I Note.*



Chell\_ZAS02065072/M



**GALAXY Note 4**

**Introducing the GALAXY Note 4.**

With an unprecedented two million pixels, the Quad HD screen makes a statement with every image. The Note 4 has a serious side too. Audio Cancellation lets you record up to eight voices and play back just the voice you want to hear, cancelling out any needless banter. Photo Note, in turn, lets you capture a drawing or written text and convert it into a digital note, then edit and save it into a format that suits you. So, do you Note?

Innovation for life.



[www.samsung.com](http://www.samsung.com) 0860 726 7864

**SAMSUNG**

## BYD LANCASTER EBUS

### ALL ABOARD

What's 18 metres long, bends in the middle, carries 120 passengers and runs nearly 300 kilometres on a charge? The world's biggest battery-powered electric vehicle, the BYD Lancaster eBus.

Named after the California city where it was designed and built, the bus was launched at the 2014 American Public Transportation Association Expo in Houston, Texas.

BYD vice president Micheal Austin challenged attendees to "throw off the shackles of a single-fuelled system – an electric platform is 'adaptable' – it becomes cleaner as you do, through the use of renewable wind, water and solar renewable power generation".

The Lancaster uses in-wheel motors capable of dealing with gradients of up to 21 per cent. A key to its performance is the iron-phosphate battery developed by BYD. It's described as fire-safe, completely recyclable, and long-cycle technology. Up to 24 hours on a single charge is possible, with single off-peak charging time of two to four hours. In fact, one bus can be used to recharge another, and the Lancaster can also feed power to the grid or a building in an emergency.

Besides strategic charging, BYD says that the Lancaster's battery can be recharged 10 000 times and still retain a 70 per cent charge. This translates as a 25-year lifespan – greater than that of the buses that use it.

BYD also unveiled its 12,2-m, battery-electric Transit bus built for the Antelope Valley Transit Authority. This bus drove 2 414 km from Los Angeles to the Houston expo at 402 km per charge, covering 1 207 km in 24 hours for an electricity cost of about R2 200.

PM





# Keep your information **SECURE...**

- 1 hour fire protection for electronic data/products
- Digital Touch pad interface
- Resettable 4-12 digit pin codes



# WIN

1 of 3  
**Yale Data Fire Safes**  
worth over **R10 000** each

The Yale Data Fire Safe has been developed to protect one's valuables in the event of a fire. A fire test is performed in a furnace where the safe is brought up to a temperature of 927°C - simulating the extreme temperatures that occur during a house fire.

This sturdy, large 43 kg safe, with dimensions of 420 x 352 x 433 mm, offers an adjustable storage configuration with a removable shelf and has storage space to be able to accommodate anything from memory sticks to external hard drive and other electronic devices, as well as built-in storage hooks for safe storage of important keys and remotes.

For more information on these products or to **BUY ONLINE** visit [www.yalelock.co.za](http://www.yalelock.co.za)  
Tel: 011 761 5000 | email: [za.info.yale@assaabloy.com](mailto:za.info.yale@assaabloy.com) | Facebook: [www.facebook.com/YaleRSA](http://www.facebook.com/YaleRSA)

To enter, answer the following question:

**Up to what temperature are the Yale Data Fire Safes tested?**

SMS the word **SAFE**, followed by the answer, your name and email address to 32697 (R1,50 per SMS; this service does not allow for 8ta numbers), or visit our Web site at [www.popularmechanics.co.za](http://www.popularmechanics.co.za). Competition closes 31 December 2014.



**Competition rules:** 1. Entry is open to anyone except employees (and their immediate families) of RamsayMedia and associated agencies. 2. Only one online entry per person. You may enter via SMS as many times as you like (R1,50 per SMS; this service does not allow for 8ta numbers). 3. Competition runs until 31 December 2014. 4. We will draw the winner(s) on 9 January 2015. 5. The prize is not redeemable for cash. 6. Prizes not claimed within 3 months will be forfeited. 7. The judges' decision is final and no correspondence will be entered into. 8. Regrettably, only South African residents are eligible for prizes. 9. By entering this competition, you agree to receive future correspondence from Popular Mechanics. You can opt out at any stage by: (a) Sending an email containing the relevant details with the subject line "opt out" to [pmmailers@ramsaymedia.co.za](mailto:pmmailers@ramsaymedia.co.za); or (b) Sending an SMS including the word "STOP" to 31699. Standard SMS rates apply.

# GAMING

NEXT GENERATION | PS4 | XBOX ONE

Also available @makro.co.za

Valid from Monday 17 November to Thursday 18 December 2014  
45/2014

3D Blu-ray Wi-Fi Bluetooth



**PS4**  
**Grand Theft Auto V Bundle**  
**6999** per bundle  
**Includes:** 500GB console, 1 DualShock controller, Headset, Grand Theft Auto V and Metal Gear Solid (283669)

3D Blu-ray Wi-Fi Bluetooth



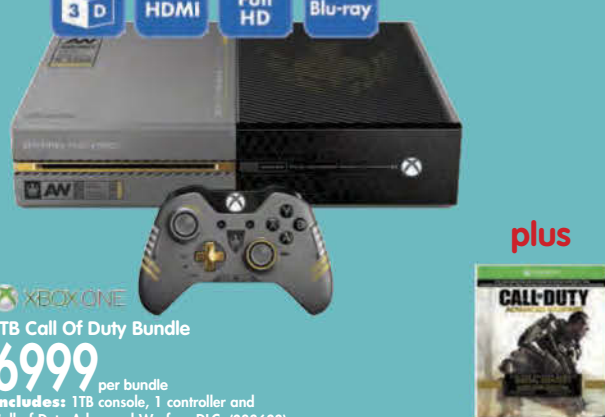
**PS4**  
**500GB Ultimate Rugby 15 Bundle**  
**7999** per bundle  
**Includes:** 500GB console, 2 DualShock controllers, camera bar, Headset, Far Cry 4 and Rugby 15 (283538)

3D HDMI Full HD Blu-ray



**XBOX ONE**  
**500GB Game Bundle**  
**6999** per bundle  
**Includes:** 500GB console, 2 x controllers, Call of Duty Ghost and Forza 5 (278775)

3D HDMI Full HD Blu-ray



**XBOX ONE**  
**1TB Call Of Duty Bundle**  
**6999** per bundle  
**Includes:** 1TB console, 1 controller and Call of Duty Advanced Warfare DLC (283623)

# makro

All prices in South African Rands



MakroSA



@Makro\_SA



Shop online at  
makro.co.za

Get your own Makro card today! Simply apply online @ www.makro.co.za, call 0860 300 999, sms "makro card" to 31144 or visit your nearest Makro store.



## Everything you could ever want. And more. For less.

Germiston 0860 304 999 • Alberton 0860 008 991 • Crown Mines 011 309 1000 • Woodmead 0860 301 999 • Strubens Valley 0860 302 999 • Centurion 0860 305 999 • Wonderboom 0860 306 999 • Silver Lakes 0860 307 999 • Vred 0860 303 999 • Polokwane 0860 009 550 • Port Elizabeth 041 397 8000 • Mbombela 0860 009 548 • Bloemfontein 0860 008 995 • Montague Gardens 0860 308 999 • Ottery 021 704 7400 • Cape Gate 0860 008 993 • Amanzimtoti 0860 008 979 • Springfield 031 203 2800 • Pietermaritzburg 033 846 3600

Customers calling from outside of South Africa, please use the following numbers: Mbombela +27 13 101 1150, Polokwane +27 15 101 1000 and Bloemfontein +27 51 101 1000

Unless we state a specific limitation, Makro will attempt to have sufficient advertised stock available to meet consumers' anticipated demands. If we still run out of stock, we will attempt to obtain the stock or we will offer you a reasonable alternative. Makro takes utmost care to ensure that all advertisements are correct. If a mistake occurs or incomplete information is printed, we will display a notice in-store with all the correct details. Prices exclude accessories used for display purposes and include 14% VAT. Makro Account Disclaimer \*Includes interest @ 22.65% p.a., excludes service fees & compulsory insurance.

\*\* Includes interest @ 22.65% p.a., service fees & compulsory insurance. All prices are indicative and actual repayments may vary based on account activity. NCRCP 38/FSP 44481.



### A MIND-CONTROLLED QUADCOPTER

↓ Bin He, a biomedical engineer at the University of Minnesota, made news this year when his grad student, wearing a high-tech hairnet with 64 electrodes, controlled a drone with his brain waves. Aside from being a great party trick, these drones would be a major step towards helping victims of stroke, spinal-cord injury or neurodegenerative disease.

**EXPECTED ARRIVAL:** Less than 10 years



## COMING SOON

Or soonish.

Early-stage breakthroughs from 2014 that should be changing lives in the (near) future.

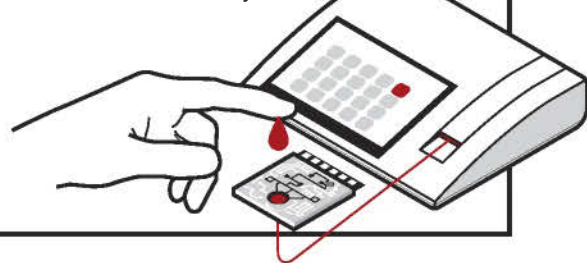
BY LOGAN WARD



### INSTANT DISEASE SCREENING FROM A SINGLE DROP OF BLOOD • Anita

↓ Goel, a Harvard-trained nanobiophysicist, has designed a handheld diagnostic lab the size of a smartphone. The GeneRADAR analyses a single drop of blood or saliva for DNA irregularities that indicate the presence of cancer, deadly viruses and other diseases. HIV researchers in Rwanda are currently field-testing the first devices.

**EXPECTED ARRIVAL:** Five years



### MODULAR NUCLEAR REACTORS • These

days even environmentalists are raising the banner for nuclear power. But two daunting issues remain: safety and cost. José Reyes and his team at Oregon State University dealt with that by creating scalable reactors that are built underground, with operating bays housed in earthquake-proof buildings and systems that shut down and self-cool without additional water or power. The only problem is getting them approved by the Nuclear Regulatory Commission.

**EXPECTED ARRIVAL:** More than 10 years

### HIGH-EFFICIENCY JET ENGINES • Fighter

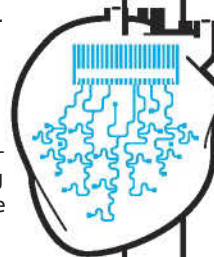
jets use fuel-guzzling, low-bypass turbofans to generate their enormous thrust. Passenger planes use high-bypass turbofans – far more efficient but not nearly as fast. GE's adaptive-cycle engine, developed by Dan McCormick and his team at the US Air Force Research Laboratory, is a hybrid of the two, with high-power and high-efficiency modes. Air Force adoption would cut 25 per cent of their annual jet-fuel use, which accounts for 10 per cent of all US aviation consumption.

**EXPECTED ARRIVAL:** Five years

### A CUSTOM-FITTED ELECTRONIC HEART WRAP • John Rogers

↓ at the University of Illinois and Igor Efimov at Washington University hope to bring heart-analysing technology to the heart itself with a custom-made wire-mesh wrap. This network of more than 30 electrodes can automatically deliver corrective shocks and feed live data wirelessly to doctors, notifying them of danger before physical symptoms even have the chance to manifest in the patient.

**EXPECTED ARRIVAL:** Five to 10 years



### A MICROSCOPE THE SIZE OF A PIN THAT GOES INSIDE YOU

Tumor biopsies can have a low degree of accuracy, not to mention a high degree of pain, so Christopher Contag and his team at Stanford University School of Medicine created a subdermal optical device that provides 3D views of living cells. It allows researchers to monitor real-time interactions between immune cells and tumours, providing insight into new therapies.

**EXPECTED ARRIVAL:** 10 years

→ **SELF-ASSEMBLING ROBOTS •** With M-Blocks, MIT grad student John Romanishin hopes to be able to drop self-assembling robots that turn into temporary bridges or go on recon missions in war zones. Tiny flywheels spinning up to 20 000 revolutions per minute allow the blocks to move around before their face-mounted magnets grab hold, forcing them into the designated shape. They have fewer moving parts than other robots and a much greater potential for miniaturisation.

**EXPECTED ARRIVAL:** More than 10 years (but only three for a toy version!)

# WHEELS



Compiled by  
ANTHONY DOMAN  
anthony@ramsaymedia.co.za

## PARIS MOTOR SHOW

AUTOMOTIVE STYLE MEETS  
HAUTE COUTURE

With 32 product launches on its opening media day, eight vast halls at Paris's exhibition centre and visitor numbers greater than any of the other big motoring expos, the Mondial de l'Automobile certainly has a profile to rival that of Frankfurt. In practice, though, the biennial German event is generally regarded as the world's biggest.

Obviously the French manufacturers go all out at the Paris Motor Show, but all the big makes are represented to a greater or lesser extent. Perhaps the new-model reveals this year were not universally top of the pile, but the glitz and glamour we've come to expect of top international shows was clear to see. The concept cars on show were generally more conservative – possibly looking more like production-ready prototypes than flights of automotive fantasy – and fewer in number. The show coincided with Paris Fashion Week, so generally one of the world's more fashion-conscious cities was in a more heightened state of awareness with regard to design matters.





## PEUGEOT QUARTZ OUTTA MY WAY

With crossover design in general seemingly headed inexorably towards the utterly conventional, Peugeot has boldly struck out in a rather different, more original direction with its vision of a next-generation SUV, Quartz. Besides its way-out looks, the Quartz features highly original and innovative use of materials, particularly in its interior. Those materials



include basalt, digitally woven fabric and chiné leather in what Peugeot calls the i-Cockpit. The hybrid drive-train produces 373 kW (500 hp) output and drives all four wheels.

It's only when you get up close that you realise how big this vehicle is: it stands more than 2 metres wide and rides on 23-inch alloys wearing 305 mm tyres. It's not that long at 4,05 metres, but short overhangs mean that interior space isn't compromised. As it's high, there is a powered retractable step.

Efficiency is a big part of the Quartz design, even down to the wheel spokes, which are kept to a minimum by the use of appropriately strong materials and are optimised for both aerodynamics and brake cooling.

The Quartz is the first-ever vehicle to feature digitally woven textile. This innovative process can create large and complex parts that can be used as soon as they come off the machine. No cutting is required, meaning there is no waste. The textile is woven with polyester fibre obtained by recycling the kind of plastic used to make water bottles. A new manufacturing process also had to be used for the composite-based bodyshell to do away with a central pillar and create scissor doors for easy access.



## TOYOTA C-HR CONCEPT

### BENCHMARK EUROPE

Not to be outdone by Peugeot on its home territory, Toyota has crafted an equally bold crossover concept for the Euro market. Toyota says the lightweight C-HR provides an "agile, engaging driving experience" with its hybrid powertrain and hints at the type of vehicle it is aiming to bring to market within the near future.

The C-HR has been conceived around a new platform designed to satisfy customers' demands for state-of-the-art handling and controllability, Toyota adds. This forms part of a focus on Europe as the most demanding market for small and mid-sized vehicles, using this region as the benchmark for defining future global A-, B- and C-segment cars. The company says Toyota Motor Europe (TME) has also become its skill centre for diesel engines, perceived quality and vehicle dynamics.



## DANGEL 4X4 DRIVE ON THE WILD SIDE

If your Peugeot Partner feels a little pedestrian, then it seems the French have alternatives. Dangel's 4x4 conversion of the Partner and its Citroën Berlingo sibling comes in several grades, starting with viscous coupling, raised suspension and an engine skid plate. In its most extreme form, it gets rear limited slip and locking differential as well as a reduction gear. The most recent addition to the options is a complementary model, compatible with ESP, with specific electronic traction control on all four wheels. Performance is said to be similar to that of the Extreme (non-ESP) version.





## HONDA JAZZ PROTOTYPE, HR-V

### SHARED PLATFORM

Three models from the Japanese family manufacturer (including the facelifted CR-V) in close proximity and in the same distinctive coppery colour showed a clear family resemblance.

The third-generation Jazz, based on Honda's new compact platform, has grown slightly compared with its predecessor. The car gets a new 1,3-litre i-VTEC engine and either a 6-speed manual or CVT.

Clever seating/storage options look set to make this HR-V a roomier, more practical alternative to its compact urban crossover rivals.



## NISSAN PULSAR NISMO CONCEPT

### ANYTHING BUT BLAND

Pulsar... now there's a name that will resonate with South Africans. Although it's a nameplate that hardly raises associations with high performance, Nissan's Nismo performance division has created a hot version that is, for the moment, being touted as a design study only.



The aggressive bodykit includes Nismo's distinctive double wing at the front, side skirts and plenty of cooling air intakes and carbon fibre. Alcantara trim and alloy pedals highlight the interior.

Mechanically, the Nismo is vastly different to its more sedate base version. The 1,6-litre four-cylinder turbocharged engine is said to produce over 180 kW and an even more powerful RS version is rumoured to be on the way. Sports suspension and steering settings and limited slip differential form part of the package.







## 4H SMERA, NEOMA

### WHY BE CONVENTIONAL?

From France's Alsace region come these distinctly... er... unusual EVs.

The Smera is described as agile and compact transport for two in a 1+1 configuration. It is also said to have generous luggage space, though with the officially quoted figure of 70/150 litres, that may be an exaggeration. Output power of its electric motor is 10 to 15 kW and, with its 6 kWh Li-po battery it has a range of greater than 80 km. Top speed is 75 km/h.

The Neoma (top) offers "the freedom to go where you wish". It provides 2+2 seating and has some beefy-looking underpinnings. Powertrain involves a 34 kW motor and 14 kWh Li-po battery. Maximum speed is 144 km/h and range is 100 km.



## HYUNDAI I40 48V HYBRID THE MILD ALTERNATIVE

Cheaper, lighter, easy to implement and offers many of the full hybrid's efficiency benefits. What's not to like about this mild hybrid concept?

Essentially an electric boost for a 1.7 diesel, the Paris Show car uses a 48 V lead-carbon battery to increase output 15 per cent. Hyundai's stablemate Kia has been pursuing lead-carbon tech lately (see PM November 2014) as an alternative to lithium-ion as an energy source for electric drive because of advantages that include cost and durability. Because no active cooling is needed, it can be stored in the spare wheel well. The Hyundai system helps cut CO<sub>2</sub> by up to 20 per cent. The clincher: it costs three-quarters of the price of a full hybrid to implement. It's lighter, too. Hyundai is upbeat about this arrangement's potential.

In the concept, a belt-driven starter generator replaces the conventional alternator. This set-up provides the car with an extra 10 kW under acceleration. Total system output of 114 kW and 360 N.m is substantially higher than the regular i40's.



## INFINITI Q80 INSPIRATION CONCEPT

### DISRUPTING THE ESTABLISHED ORDER

Designed to disrupt the premium segment, this non-traditional concept flagship is said to have production potential. Naturally, it is as luxurious as any existing rival from the premium brands. Under the bonnet is a hybrid arrangement featuring twin-turbo 3.0-litre V6 producing over 400 kW, said to point the way to future Infiniti powertrains. Production is forecast for 2016.

## SSANGYONG XIV-ADVENTURE, XIV-AIR CONCEPTS

### COMING SOON?

Judging by these concepts, Ssangyong could be on the comeback trail. The slightly wacky looks of not so long ago appear to have been ditched in favour of the styling you see on these neat crossovers. Apparently these are not mere concepts, either, but close to production models of the X-100 compact SUV. At any rate, the information provided by Ssangyong says that they are due to go on sale in 2015. Engines are 1,6 four-cylinders, both diesel and petrol, with auto or manual gearboxes. The XIV drive-train is either four-wheel drive or two-wheel drive. The Air appears to be more of an urban-focused runabout, whereas the Adventure has a more rugged off-road look about it.



## TOYOTA I-ROAD

### GETTING PERSONAL

Densely populated areas such as Europe's major centres are a natural habitat for Toyota's i-Road personal mobility vehicle, so it's not surprising that Paris was chosen to announce that this vehicle will be taking part in a three-year test programme in the French city of Grenoble. The two-seater three-wheeler PMV combines the manoeuvrability and small footprint of a motorcycle with the weatherproofing, not to mention greater safety, of a car. Add to that low running cost thanks to its electric drivetrain, with a projected range of 50 km, and you've got the ideal city car. It can recharge in 3 hours.



An important feature of the i-Road is its Active Lean technology. Working in conjunction with rear-wheel steering, controlled by a conventional steering wheel, the system has a lean actuator motor and gearing mounted above the front suspension member, Toyota says. An ECU calculates the required angle of lean, based on steering angle, vehicle speed and information from a gyro sensor. The system automatically moves the wheels up and down, in opposite directions, and can apply a lean angle to counteract the centrifugal force of cornering.

The system also operates when i-Road is being driven straight ahead on a stepped surface, the lean actuator automatically compensating for changes in the road surface to keep the body level.

The Grenoble trial is aimed at working towards the urban transport of the future, in partnership with the local authorities. It will target improvements in the efficiency and effectiveness of public transport systems by interconnecting them with electric PMVs and encouraging commuters to use a PMV for the first or final few kilometres of their journey, linking in to their use of a bus, tram or train for the greater part of their trip.

## VENTURI AMERICA NO ORDINARY BUGGY

The curvy America may not have the most aggressive looks around, but it doesn't lack for performance. What Venturi calls its all-terrain sports car has a massive 300 kW on tap. Venturi claims 0 to 100 km/h in 4,5 seconds, 0 to 200 in 14 seconds and a top speed of 220.

The America's battery pack is a hefty 53 kWh unit that's said to be good for a 250-km range. A full recharge takes under 4 hours.

Thanks to its relatively compact dimensions and carbon-fibre construction, the America should be wieldy on-road or off. Overall weight is around 1 500 kg and, with ground clearance of 280 mm it should manage okay in more rugged going.

Thirty to 40 years ago, Venturi was better known as a producer of sports cars, but has lately concentrated on electric propulsion. The company holds the world land speed record for electric cars.

The America is being built in a limited run of 25 from next year.





## JAGUAR XE

### KEEPER OF THE DNA

Jaguar is targeting the burgeoning medium premium sector with its new XE. That sector is expected to grow from 1,5 million cars to 1,7 between 2015 to 2020, a Jaguar spokesman told media at the pre-Paris Show briefing on a car that's seen as one of the most important in the company's history.

Dubbed the most accessible Jaguar ever, the XE will go on sale starting at 27 000 pounds on its UK home market. Although more broad-based in outlook than the outright luxury models above it, it's seen as part of a logical plan to have different sub-levels within the brand.

The car is developed from an entirely new model architecture, though it's described as a custodian of the Jaguar DNA. "Any car based on it is guaranteed to be Jaguar," we were told.

The XE is also the most efficient and sustainable Jaguar ever. A key element of that is its aluminium construction. Besides being light, rigid and sustainable, the new architecture will enable Jaguar to produce higher volumes with higher quality. As part of a 1,5 billion pound investment, the company has built a new aluminium body shop the size of 10 football pitches – the largest in Europe – and has 613 robots on a flexible state-of-the-art production line capable of producing both Jaguar and Land Rover models.

The vehicle will also feature cutting-edge tech, among the most advanced in its segment. The super-efficient in-house-developed Ingenium engine line is an example of that. The 2,0-litre Ingenium diesel produces 132 kW with economy of 4,1 litres/100 km and 109 g/km CO<sub>2</sub>. The XE is also the most aerodynamic Jaguar ever, with a drag coefficient of 0,26.

Similarly cutting-edge is the integral rear axle, usually only found on vehicles a class above. Stereo forward-looking cameras enable lane departure warning and auto high-beam assist, and the laser head-up display, much sharper images than conventional designs. A "deployable bonnet" delivers enhanced pedestrian protection by optimising the front crush zone in a pedestrian impact.

There's also an innovative new traction technology, All-Surface Progress Control (ASPC), for pullaways on slippery surfaces. Effectively a low-speed cruise control combined with traction



**XE's entirely new model architecture makes use of aluminium in class-leading quantities; Ingenium diesel 2,0-litre engine produces 132 kW, yet gets 4,1 litres/100 km.**

control, it is based on 20 years of development of the company's Terrain Response system. The driver sets an appropriate speed with the cruise control and the car manages power and braking to ensure optimum traction. All the driver has to do then is steer – there's no need to touch the pedals.

Intuitive new InControl Touch is employed in the XE's infotainment system, which features an 8-inch touchscreen.

But it is a Jaguar, after all. A sports sedan. And tech aside, the underlying thinking was to develop the best driver's car in its segment.

With supercharged 3,0-litre V6, the XE is capable of 0-100 km/h in 5,2 seconds. Transmissions available are six-speed manual and eight-speed automatic.

Questioned about a flagship high-performance model like the competitors' M and AMG models, Jaguar would not be drawn on the possibilities. "We are concentrating on the core of the sports sedan market," a spokesman said. The current performance model uses the 250 kW supercharged V6 rather than the 380 kW version available apparently because it offers better balance in the context of the lightweight nature of the car. Incidentally, the car is designed for all-wheel drive and Jaguar will deploy it in future.

## LAND ROVER DISCOVERY SPORT

WHAT'S IN A NAME? PLENTY

Instead of the design, styling or engineering, it seems that the choice of name for Land Rover's latest model has drawn more than its fair share of the discussion around the new arrival.

It's true that for the moment "Discovery Sport" doesn't adequately encapsulate how truly different the new vehicle is from what's gone before. The way Land Rover sees it, Discovery Sport introduces a rethink to the company's design approach. The idea is to clearly differentiate between the other Land Rover families: Luxury (Range Rover), Leisure (Discovery) and Dual-Purpose (Defender).

If one had to pigeonhole the new vehicle it would probably be "compact crossover". What sets the Sport apart from the rest, though, is its unique-in-class 5+2 layout. That's been made possible largely thanks to an innovative rear suspension design. The all-new lightweight aluminium-rich multi-link rear axle, says Land Rover, heightens agility and increases axle articulation. It also reduces interior noise and minimises intrusion of the rear suspension turrets into the load space – a key to optimising load space and 5+2 seating. Second-row seats tilt and slide for maximum interior configurability. Up to four 12 V power points and six USB charging sockets can be specified for all three rows, too.

At launch the Discovery Sport will be equipped with a range of four-cylinder turbocharged petrol and diesel engines. Both the all-alloy Si4 2.0-litre petrol engine and the 2.2-litre turbodiesel feature stop-start technology, high-pressure direct injection, low-friction internal components and smart regenerative charging. The ED4 turbodiesel derivative to be introduced later will deliver an estimated 119 g/km of CO<sub>2</sub>.

Both 9-speed automatic and 6-speed manual transmissions are available, along with a choice of two- or four-wheel drive. In keeping with its pedigree, the Sport is said to offer unrivalled all-terrain performance courtesy of optimised approach, departure and breakover angles, plus Terrain Response and Wade Sensing technology. At the same time, it offers "connected on-road handling" thanks to optimised electric power-assisted steering, MagneRide dampers and Torque Vectoring by Braking.

Three choices of drivetrain are available: two-wheel drive, permanent four-wheel drive or Active Driveline. The latter



switches seamlessly between two- and four-wheel drive for reduced emissions and increased on- and off-road capability.

Land Rover says that with approach, departure and breakover angles of 25, 31 and 21 degrees respectively, Terrain Response technology (on four-wheel-drive derivatives), and the ability to wade to 600 mm, Discovery Sport offers class-leading capability in all conditions.

Discovery Sport's full suite of all-terrain technologies includes:

- Hill Descent Control (HDC)
- Gradient Release Control (GRC)
- Wade Sensing
- Roll Stability Control (RSC)
- Dynamic Stability Control (DSC)
- Electronic Traction Control (ETC)

- Engine Drag torque Control (EDC).

Safety features include a suite of driver aids, a first-in-class pedestrian airbag, autonomous emergency braking, and a state-of-the-art bodyshell featuring both ultra-high-strength steel and lightweight aluminium. There's also a Head-Up Display and an all-new 20-cm touchscreen infotainment system featuring Land Rover's innovative InControl, said to put Discovery Sport at the cutting edge of in-car connectivity. Developed in conjunction with Bosch SoftTec, InControl Apps enables vehicle-optimised smartphone apps to be displayed and controlled with their original look and feel from the touchscreen.

The Discovery Sport goes on sale worldwide in 2015.





Interior is crucial to the Discovery Sport, says design chief Gerry McGovern, describing the new car as “almost... being designed from the inside out”. Its reconfigurable 5+2 layout occupies the same footprint as a standard 5-seat SUV.

### FLOATING A NEW CONCEPT

Razzmatazz ruled as the Discovery Sport had its coming out under the gaze of the world's media on the eve of the Paris Motor Show. Appropriately, for a launch event held on the banks of the River Seine, the vehicle arrived on a barge. Admittedly, this was no ordinary canal traveller, but one dressed up as a floating 4x4 course, complete with hills and wading pool.

Addressing media gathered for the occasion, Gerry McGovern, Land Rover design director and chief creative officer, explained that the Discovery Sport was a good example of the company's search for “white space opportunities”.

The new vehicle is, he stressed, not a replacement for the Discovery. (That's still coming.) It's not a replacement for the Freelander, either. (That's not coming, it seems.)

So much for what it's not. What *is* it, then?

“In design terms, it's a massive departure from where we currently are,” McGovern said. He described it as stretching the

brand's appeal to make it more universal. “But not to the point that it's generic.” It retained classic Discovery elements, such as the play of verticals vs horizontals. “It's got some Discovery DNA... clamshell bonnet, floating C pillar.”

The thing that really sets it apart is that it is compact and sporty, but with a cavernous interior. And it's that interior that he singled out for particular mention. “One of the things that is crucial for Discovery is the interior. Because of its versatility – it is almost a car that's designed from the inside out.”

Although like other Land Rovers the Discovery Sport would be highly capable off-road, it's clear that the designers see it as very much at home in an urban setting, “We wanted to remind ourselves that this is a vehicle that will be seen in every major city in the world... relevant, contemporary, premium,” McGovern said. “It's designed for people that lead busy lifestyles; a family vehicle. The real trick behind this is the flexible, reconfigurable interior. It's the same footprint as a 5-seat SUV. That is our big differentiator.” **PM**

---

# CHASING THE SUN

---

This year's Sasol Solar Challenge provided a test of man, machine – and character

STORY AND PICTURES  
BY SEAN WOODS



**THE ENDLESS BACK COUNTRY ROADS**, the oppressive cockpit and the relentless, energy-sapping assault on the mind and body of individual and team alike are now a distant memory. For the elite few, the 2014 Sasol Solar Challenge went according to plan, more or less. For the rest, it was an education. In some cases, an often brutal education. That's the thing about the Sun: fly too close and you get burnt.

The gruelling, eight-day country-wide challenge (see "The challenge") showcases advanced technologies and mechanical derring-do. It brings together engineers, academics, scientists – just general solar geeks – and puts their Sun-powered creations to the test. Thing is, this test doesn't take place in a comfortable air-conditioned lab or secure closed circuit unbothered by traffic and in ideal conditions. Competitors go head to head in the real world, on actual roads and in the weather that happens to be current at the time.

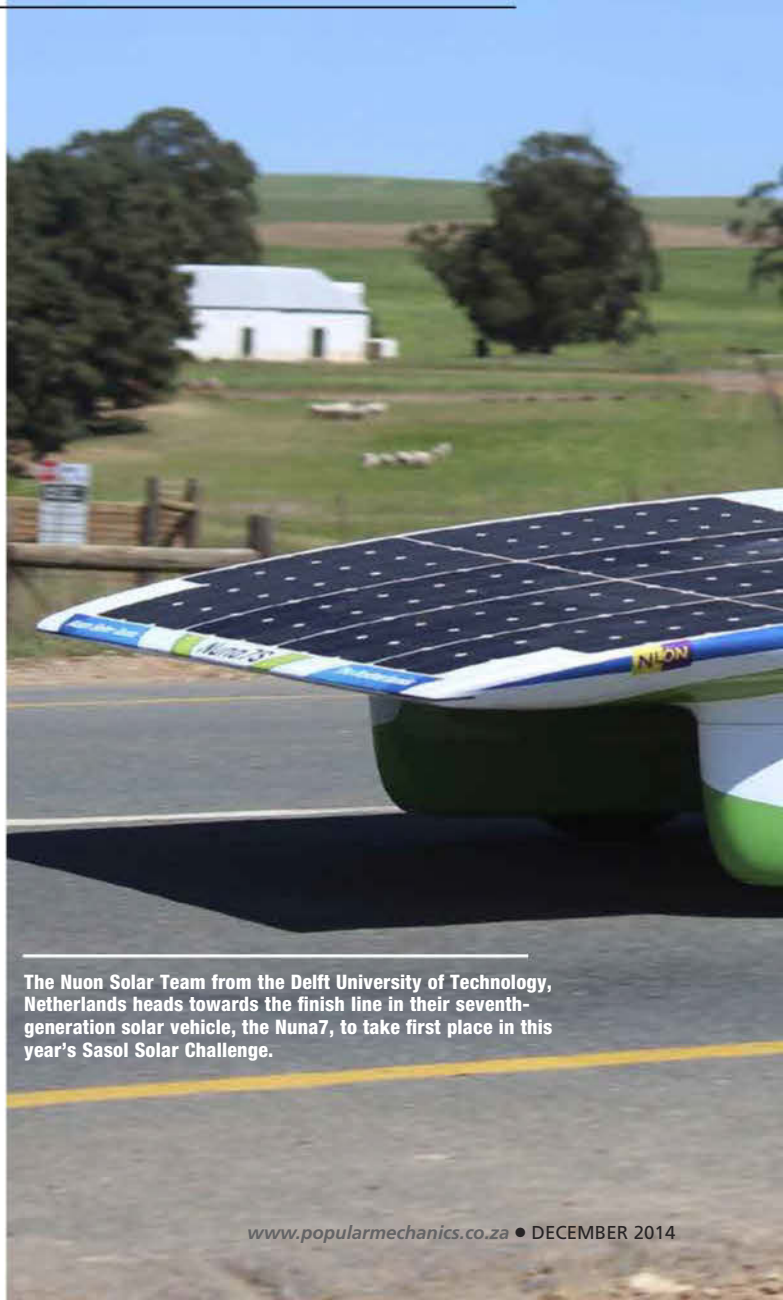
## GLOBAL SOLARPOWER

Here's how much hope anybody realistically had of beating the Dutch team: none. The eventual winners (was there ever any doubt?) could have given the rest a head start and still finished first.

Five times world champions and twice runners-up, the Nuon Solar Team from the Delft University of Technology (DUT) were indisputably in pole position. Having competed on the world solar car circuit for the last 14 years and now on their seventh vehicle, the Nuna7, their agenda was simple: use the Sasol Solar Challenge as a training session for the World Solar Championships to be held in Australia next year.

As you can imagine, the slick, professional manner Nuon Solar went about their business was a wonder to behold. In fact, while watching them attend to their vehicle at the mandatory control stops along the route, I couldn't help but think Formula 1 pit crew. It was that obvious how seriously they had prepared for the race. Their training regimen even included driving their vehicle around a game park in the Netherlands before flying in for the Challenge. You know, just in case they encountered any indigenous wildlife on the road from Pretoria to Cape Town.

So they had a wealth of knowledge and experience. Added to that, they had a budget that had locals drooling: upwards of R30 million. Apart from meaning all the obvious stuff, like the ability to afford sophisticated gear, it has another very real advantage –



The Nuon Solar Team from the Delft University of Technology, Netherlands heads towards the finish line in their seventh-generation solar vehicle, the Nuna7, to take first place in this year's Sasol Solar Challenge.



## THE CHALLENGE

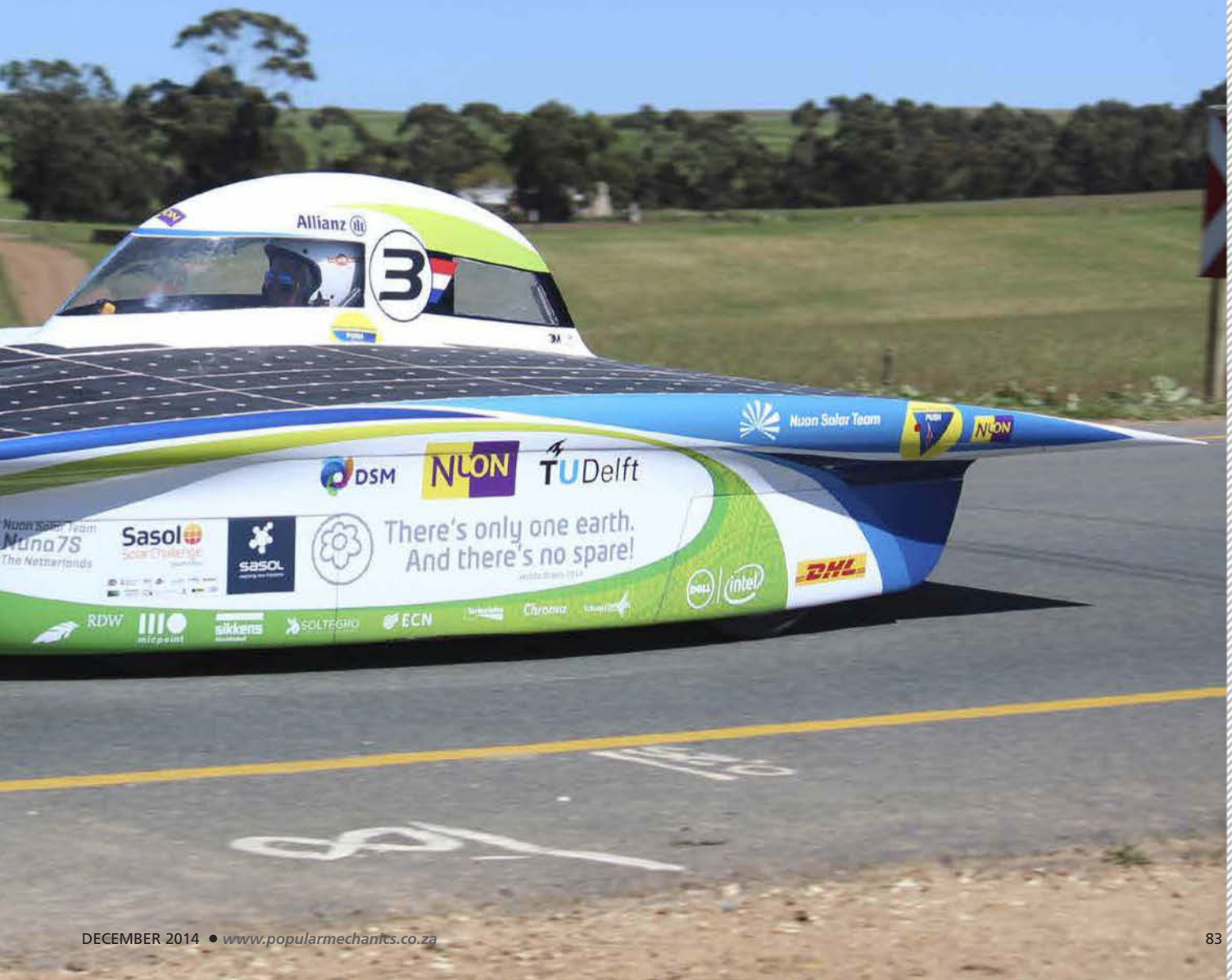
Ranked one of the top global events of its kind, the Sasol Solar Challenge is an eight-day country-wide endurance challenge designed to demonstrate – and test – the sophistication and performance of solar-powered vehicles. It is held every two years, under the auspices of Motorsport South Africa and the sport's international governing body, Federation Internationale de l'Automobile (FIA).

The challenge is a collaborative initiative that engages university students, lecturers, scholars, individuals, industry and government. Apart from promoting innovation in sustainable energy and transport technology, the challenge is also a platform for the promotion of science, technology, engineering and mathematics (STEM) subjects. The competing vehicles are, effectively, laboratories on wheels.

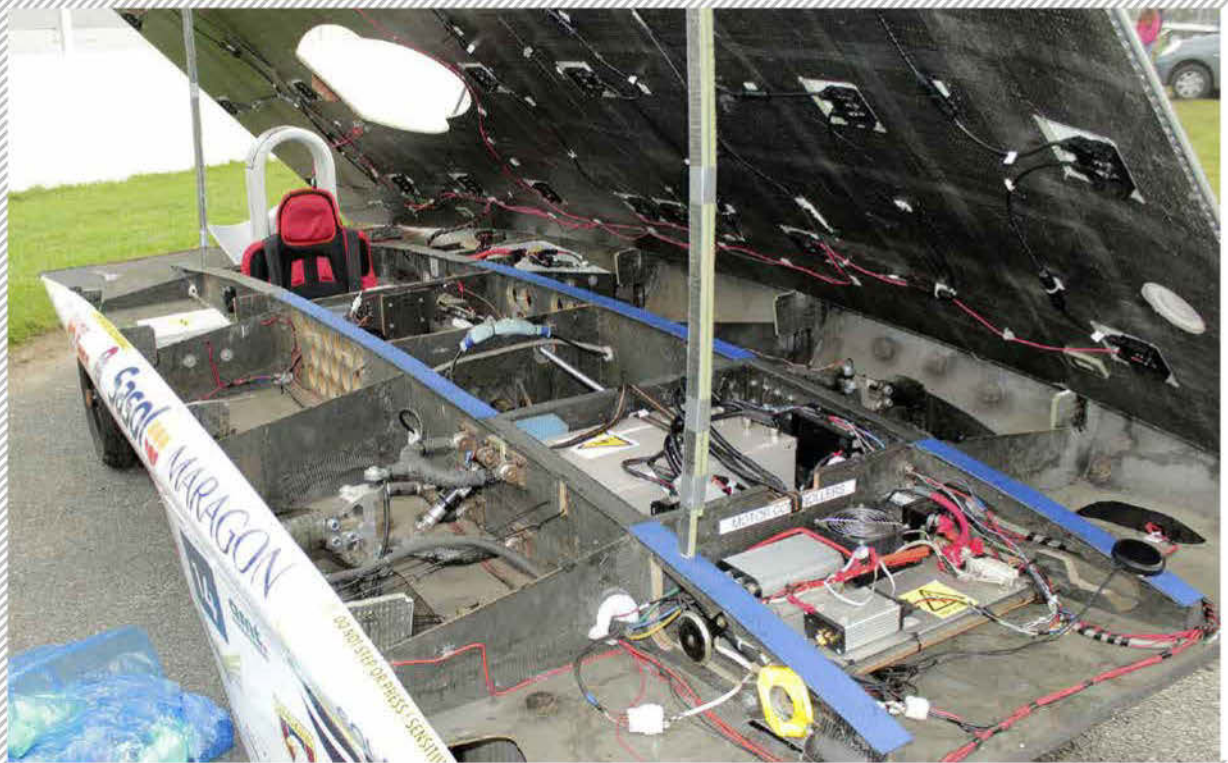
This year's event kicked off from Pretoria on 27 September and ended in Cape Town a week later. The main route spanned approximately 2 000 km; teams had the option of determining their daily distances travelled by completing various loops, covering distances of between 58 and 132 km at stops along the way.

## AND THE WINNER IS...

1. **Nuon Solar Team** – Delft University of Technology, Netherlands.  
Distance travelled: 4 227,8 km
2. **Anadolu Solar Team** – Eskişehir, Turkey; 2 733,1 km
3. **Team University of KwaZulu-Natal** – Durban; 2 418,3 km
4. **North-West University** – Potchefstroom; 2 360,6 km
5. **University of Johannesburg** – Gauteng; 1 608,9 km
6. **Solar Eagles** – Maragon Private School Olympus, Pretoria; 1 268,5 km
7. **Tshwane University of Technology** – Pretoria; 1 213, 8 km
8. **Near East University** – Nicosia, Northern Cyprus; 630,3 km
9. **WITS Solar Car Team** – Johannesburg; 336,2 km
10. **UCT Solar Car Team** – Cape Town; 222,6 km







**ANADOLA SOLAR**



**TSHWANE UNIVERSITY OF TECHNOLOGY**



**NUON SOLAR**



**WITS SOLAR**



**UCT SVG**

Teams enveloped in morning mist prepare their vehicles for the final day of racing at their last stopover in Swellendam.





**Far left: Team Solar Eagles from the Maragon Private School Olympus prop up their solar array to catch the weak morning light penetrating the mist before hitting the road on the final leg of the Sasol Solar Challenge 2014.**

**Left: The pit crew of Dutch team Nuon Solar spring into action as they prepare their vehicle for the last round of loops in Caledon before continuing to the finish line in Cape Town.**

**Below: The Near East University team from Nicosia, Northern Cyprus, push their car to the start line in Swellendam.**



the ability to carry expensive spares, and plenty of them.

Nuon's strategy this time around was a case in point. They lost out to the Japanese in the 2012 Sasol Solar Challenge, they felt, largely due to a motor with too little torque for the hilly sections of the Western Cape. This time, they brought two motors – one configured for high torque and low speed (for hills) and another geared to deliver less power and more speed (for flatter sections) – and just swapped them out as required.

For Nuon Solar, the expense of carrying the extra motor was a relatively affordable R280 000, give or take. For some of the more cash-strapped local teams, such as the University of Cape Town (with a mere R350 000 in their kitty), however, options such as this were completely out of the question.

Cash aside, nothing quite builds success like success. Because of Nuon Solar's successful track record, their university backs them to the hilt. Students who join the team have all their studies suspended for a year, allowing them to concentrate fully on the project. Plus, as DUT has been running its solar car programme for 14 years and builds a new vehicle every two, there are plenty of postgraduates with experience around to lend a constructive hand.

## BAD LUCK IS ALL I HAVE

On paper, the University of Johannesburg's Solar Team seemed quite capable of making life difficult for the Dutch. Like Nuon Solar, their sights were firmly set on the world champs in Australia next year. And, while they didn't have as much experience as the Dutch, UJ are by no means novices either, with plenty of in-house experience to draw from. In fact, their solar car programme started back in 2011, when a small band of students got together without any funding to enter their first race in 2012. Since then, the project's grown in leaps and bounds, drawing in many students from various electrical, mechanical and design faculties. Just as importantly, the university has had four years to build strategic relationships with important industry players and sponsors.

Clearly, all the effort paid off. As far as observers and fellow competitors were concerned, UJ's third-generation vehicle, the Ilanga II (Zulu for sun), literally stole the show with its good looks and innovative use of technology.

Highly efficient (35,4 per cent) Gallium Arsenide solar panels – the same type as those used on the Mars Rover – allowed the team to build the smallest and, at 185 kg, the lightest car in the Challenge. Ultra-light materials such as carbon fibre, Kevlar and Airex foam core were used for the body and suspension system. The battery pack, consisting of over 400 individual lithium-ion cells, weighed less than 20 per cent of the total weight of the car. The vehicle's 3D printed steering wheel included a unique electronics board and LCD display with several buttons, including a booster button for a spurt of acceleration when needed. And its axial flux brushless DC hub motor, designed specifically for solar racing, was chosen for its efficiency and high peak power output.

Ilanga II also contained a full telemetry system. That allowed the team member responsible for race strategy and optimisation of the vehicle to remotely monitor the power output of the solar panels and the power levels in the battery pack. After considering the terrain and weather conditions, he or she could then advise the driver how to coax the furthest distance possible out of the available power.

That was on paper, at least. Sadly, things took a mechanical turn for the worse, fast. The way UJ's Nickey Jansen van Rensburg sees it, the reason largely came down to not having enough time to test the vehicle at high speed (think breaking point) before the race. "We never had the opportunity to really push Ilanga II to its limits," she says. "That was due to various reasons, one being the recent metalworkers' strike, which meant we received components late, and other subtle, late design changes we made to the suspension." The first time they had a chance to go flat out was during the race.

Not wanting to push their luck, the team took things easy on day one. Day two, and feeling much more confident, they started to push things – managing to clock up the second-longest distance for the day, with enough daylight spare to fully recharge their batteries before sunset.

Day three, and the wheels fell off, literally. While negotiating a stretch of roadworks between Bloemfontein and Colesberg, Ilanga II's suspension was subjected to nasty jolts every time it crossed the ridge in the road where old and new tar met. The end result: snapped tie rod ends. Jansen van Rensburg explains:

"This was a design feature of the car because, if they couldn't snap, they would have pushed through our solar array. Unfortunately, we simply didn't test the car enough to know exactly where that breaking point would be."

Reinforcing the suspension, then having to source larger tie rod ends while in the middle of nowhere (to accommodate the extra weight added to the vehicle) took three valuable days out of UJ's race – leaving them in the unenviable position of having to play catch-up. Says Jansen van Rensburg: "I'm completely heartbroken for the team; we know this car can do better. We couldn't believe our bad luck at the time, but with hindsight we're quite pleased. As far as preparing for Australia goes, this could actually be the best thing that could've happened. We definitely see ourselves as serious contenders for the world championships."

## PODIUM FINISH

Having finished the 2012 Sasol Solar Challenge with a respectable third place and picking up records for completing the greatest distance of all South African vehicles over the course of the race (2 000 km) and in a single day (300 km) with their first solar car – the University of KwaZulu-Natal (UKZN) had high hopes for this year's Challenge.

Their new vehicle, named iKlwa (after the short spear used by Zulu warriors under their famed leader Shaka Zulu), gave the team – comprising eight undergraduate and postgraduate students and two lecturers – a chance to focus their efforts on minimising aerodynamic drag. UKZN's Clinton Bemont elaborates: "We didn't focus on weight that much as we realised it only really affected rolling resistance, which we mitigated by fitting purpose-built solar racing tyres pumped up to 8 bar to the vehicle. Our attitude was, when driving at high, constant speeds aerodynamic forces were much more critical."

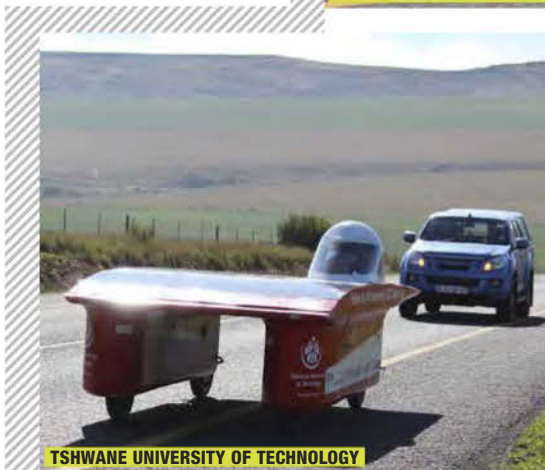
Because of financial constraints, the team opted for a combination of silicon solar cells (with efficiencies of 22 and 24 per cent) normally used for high-end terrestrial applications. As solar panels gain about 1 per cent in efficiency for every 1 degree drop in temperature, they created pathways underneath their array to allow moving air to cool them while driving. The vehicle itself was made out of carbon fibre to give it a high strength to weight ratio. They also fitted a completely secret "mystery" component (which the university intends patenting) that Bemont swears made a huge difference. Oh, and it featured regenerative braking, too.

The one weak link in UKZN's team was the fact that no electrical engineering students were involved. This had very real consequences on the first day of the race. Someone (whom the team insists remains anonymous – the feelings are still too raw) initiated the incorrect start sequence by flipping switches in the wrong order, causing the vehicle's electrics to pop.

Here's what basically happened: the maximum power point trackers (MPPT), acting as an interface between the solar panels and large capacitors to optimise voltage and power, became overloaded by the capacitors – flooding the vehicle's sensitive 5 V electrical system with a whopping 100 V. Says Bemont: "We carried some spares as backup, but the one component we really needed we didn't have. It took us about half a day just



UNIVERSITY OF KWAZULU-NATAL



TSHWANE UNIVERSITY OF TECHNOLOGY



NORTH-WEST UNIVERSITY



UNIVERSITY OF JOHANNESBURG

to isolate the problem, we then ended up working through the night, even soldering diodes out of an old TV we'd found in someone's garage to get things working again."

Although their car was back on the road, the team figured their race was over, so they settled down to just enjoy the race. As each day of the challenge progressed, they surprised themselves by steadily closing the gap between them and their main rivals, North West University (NWU). And, in a dramatic last day dash to the finish line, they managed to pass NWU to secure a third place finish. Team leader Kirsty Veale sums up the sentiment of the team: "We're more shocked than anything else. For us, the last day of racing was the most amazing standoff in existence – we're so happy we managed to catch up!"





ANADOLU SOLAR



NUON SOLAR



SOLAR EAGLES

Flush from their success, UKZN are now trying to secure about R1 million in funding so they can make it to Australia next year.

### MAYBE NEXT YEAR

The University of Cape Town (UCT), having never competed in the Solar Challenge before, found themselves in a very similar situation to where UJ had found themselves four years back. And, according to UCT SVG's Moin Hanif, his rookie team understood exactly what they were walking into right from the start. As first-time entrants in the Solar Challenge they had no pool of expertise to draw from. The entire team, made up of second- and third-year students, were busy with exams. And anyway, the first two years of engineering studies concentrate mainly on maths and science, with only a smattering of mechanical theory – it's only in the third and fourth years that students get to concentrate on cool stuff such as mechanical design. As a consequence, team members didn't even have much experience among themselves.

Even worse, they received the components for their car only in June – giving them less than three months to build their vehicle in-house from scratch. That they even entered says a lot.

For UCT SVG the first two days of the eight-day challenge

were complete non-starters. Says Hanif: "Around that time we were seriously thinking about withdrawing. It was so frustrating, our electrics worked fine, but we were having so many mechanical problems." Their problem was the aluminium frame they'd used for the chassis. Initially designed for a small car, its piping proved to be too narrow a diameter to handle the forces at play. "Whenever the car accelerated or braked, the frame would either bend or break," Hanif says. "So, working through the night, we reduced the car's height by 20 cm and added extra metal reinforcement. Unfortunately this made our car weigh 350 kg, which was a huge disadvantage, but at least we could keep going."

### WINNERS, NOT LOSERS

UCT SVG may have come stone last, but I don't see it that way. The underlying goal of the Sasol Solar Challenge is to increase the interest in science, technology, engineering and mathematics (STEM) subjects. It's also about increasing the levels of knowledge around electric motors, battery systems and vehicle aerodynamics. With that in mind, seeing as UCT SVG was the team that experienced the steepest learning curve, maybe they walked away the true winners of this year's race. In any event, even if they feel like they didn't, at least now they have a solid foundation to build on for the next Sasol Solar Challenge taking place in 2016.

For more, visit [www.solarchallenge.org.za](http://www.solarchallenge.org.za)

PM



GRILL A TURKEY

CUT ANYTHING

A TABLE FOR EVERYONE

ASK ROY

# SKILLS

"My Cowboy Cauldron is the best grill I have ever owned. It'll last a lifetime and holds heat better than any kettle grill." - Chef Ben Ford



PHOTOGRAPHS BY PLAMEN PETKOV



## THE CHALLENGE:

# COOK CHRISTMAS LUNCH ON THE GRILL

It was meant to be cooked this way. It will taste better, too.

**EVEN IF YOU'RE IN CHARGE**, a substantial part of cooking a big festive season meal is waiting for the turkey to happen. Sitting in the dining room, peering through that little oven window at it like it's some kind of zoo animal. There is a better way. Cook your feast on the grill and you control the elements. You add the smoke and the flavours. You change the temperature. You're actually cooking your food the same way you're actually driving a car with a manual transmission. Top Los Angeles chef Ben Ford is a guy who believes in this kind of elemental sorcery. He'll roast anything. His backyard looks like it was cast in a mediaeval iron forge. So he created a menu for us: a turkey smoked over sweet applewood and corncobs; ember-cooked potato packets he came up with for a camping trip; a grilled fig and dried fruit chutney; and grilled green beans with shallots and hazelnuts. If you're going to cook Christmas lunch with your bare hands, you want to end up with an impressive meal.

## GRILLING

## THE TURKEY

## TURKEY BRINE

2 cups coarse salt  
1 cup sugar  
1 litre apple juice  
2 Tbsp black peppercorns  
5 star anise pods  
5 bay leaves  
2 dried chillies  
1 Tbsp whole allspice berries  
1 Tbsp juniper berries  
Ice

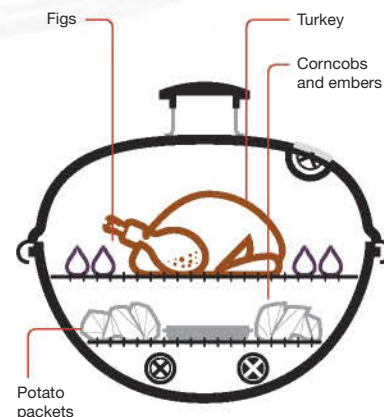
## TURKEY BUTTER RUB AND BASTE

¼ cup onion powder  
¼ cup paprika

¼ cup garlic powder  
¼ cup coarse salt  
¼ cup black pepper  
1 Tbsp ground sage  
2 cups unsalted butter, fully softened  
2 Tbsp fresh thyme, chopped  
1 Tbsp lemon zest

## TO STUFF THE TURKEY

1 large onion, quartered  
A handful of fresh thyme sprigs  
Salt and pepper

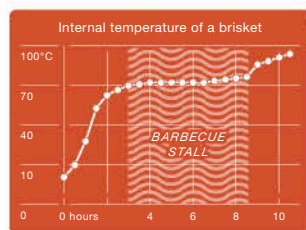


**At peak cooking time, about 30 minutes before the turkey comes off the grill, your layout should look like this: turkey over the pan, figs over the heat, and the potato packets down in the embers. All recipes at [popularmechanics.com/grill](http://popularmechanics.com/grill).**

- 1 Start with a 5-kilogram turkey. You'll need a 28-litre cooler to brine the bird in before you smoke it, two 7-kg bags of natural lump charcoal, one 1,5-kg bag of applewood chips, an aluminium roasting pan, a basting brush, and your corncobs.
- 2 Remove the neck, giblets and heart from the cavity. Discard the liver. Put everything else in an airtight container and refrigerate until you're ready to make the gravy (you can find the recipe at [popularmechanics.com/grill](http://popularmechanics.com/grill)).
- 3 Bring 5 litres of water to a boil. Add salt and sugar. Stir in the apple juice, peppercorns, star anise, bay leaves, chillies, allspice, and juniper berries. Pour everything into the cooler. Add enough ice to make 10 litres.
- 4 Rinse the turkey and clean it out

well. Put the turkey in the cooler neck first and place a heavy plate on top of it to keep it submerged. Put the cooler in a cool, dark place overnight.

5 The next day, remove the turkey, rinse it, and pat it dry with paper towels. Combine all the dry rub ingredients. Dust the body cavity with 1 tablespoon of that, and then add the rest to the softened butter, mixing well with a spoon, along with the thyme and lemon zest. Smear half of this butter rub under the skin of the breast and all over the outer surface of the skin as well. Put the remaining butter in a saucepan and place it near the grill. You'll use it to baste the bird while you cook. Finally, stuff the cavity with the onion quarters and thyme sprigs.



**THE PHYSICS OF GRILLING: BARBECUE STALL** You know how it goes: you put your meat on the grill and the meat gets hotter, like it's supposed to. And then it gets to 65 degrees and the temperature stops rising. For hours. This is barbecue stall, the dreaded dead period when water evaporation is cooling the meat as quickly as fire is heating it. A good way to avoid it is to place your meat about 7 cm above a pan of water. "The water will generate a lot of humidity and the stall temperature will rise," says Greg Blonder, our physics expert. "In the case of a turkey, you can often get the stall temperature to rise above the cooking temperature." Which means it will be done before you have a reason to panic.



## GRILLING

HERE'S THE PLAN:

# A

**A FEW DAYS BEFORE YOUR FEAST**, cut the kernels off four corncobs and leave the shorn cobs to dry out. Find the recipes for the potatoes, green beans, chutney, and cider on our Web site, at [popularmechanics.com/grill](http://popularmechanics.com/grill). Then, the day before, brine the turkey. The recipe's on the previous page. On Christmas morning, remove your grill's grate and light half a chimney starter's worth of charcoal. When the embers are red-hot with white ash, divide them into two piles on either side of the grill. Break a corncob in half and place one half on each pile along with a handful of fresh coals and a handful of applewood chunks. Put an aluminum pan between the piles to catch drippings.



### WHAT ABOUT THE WEATHER?

Well, it's summer, so generally you'll have no worries about temperature. But it might be too windy. "Wind can blow away the bubble of warm air that insulates your cooker, and then you have to keep putting in fuel," says Greg Blonder, physicist and expert at [amazingribs.com](http://amazingribs.com). If you're stuck in a squall, you can build a three-sided, roofless shed to divert the worst of the gusts. Just don't block the vents.

Open all the top vents to allow air circulation. Open half of the bottom vents. Close the lid for about 5 minutes; you'll start to see white smoke escaping through the vents. Place the turkey on the grate between the two piles of coals, over the drip pan. Every half-hour, baste the bird with melted butter, break a corncob and add half, as well as a handful of applewood chunks and a handful of charcoal, to each pile of embers. You may have to lift a corner of your grate with tongs to do this.

After about 6 hours, or 30 to 35 minutes per half a kilogram, insert an instant-read thermometer between the thigh and breast. When it registers 74 degrees, you're done. Remove the turkey from the grill, place it breast down in a roasting pan, and tent a piece of foil over it. Let it rest 20 to 30 minutes before carving.

### MULLED CIDER\*

PERHAPS NOT THE IDEAL DRINK FOR A TYPICALLY WARM SOUTHERN HEMISPHERE YULETIDE, BUT HEY, IT FITS RIGHT IN WITH THE BACKGROUND MUSIC OF *WHITE CHRISTMAS* AND *RUDOLPH THE RED-NOSED REINDEER*.

### FRUIT CHUTNEY\*

30 MINUTES BEFORE THE TURKEY'S DONE

\* See additional recipes at [popularmechanics.com/grill](http://popularmechanics.com/grill).



## CORNCOB-SMOKED TURKEY

(See previous  
page.)

## GREEN BEANS WITH SHALLOTS AND ROASTED HAZELNUTS\*

ONCE THE TURKEY'S OUT

## IF YOU'RE USING A GAS GRILL

Instead of using corncobs, fill a packet of aluminium foil with 3 cups cornflour and 3 cups of wood chips. Poke holes in the foil. Preheat the grill to 120 (250 F), then turn off the heat on one side. Place an aluminium pan on the side of the grill that is turned off and put a roasting rack in it. Fill the pan with 5 cm of water. Place the foil packet of cornflour and wood chips on the hot side of the grill. Set the cooking grates in place and cover the grill with the lid until the packet starts smoking. Open the lid and put the turkey on the roasting rack. Close the lid to begin smoking the bird. Baste the bird with melted butter every half-hour.

## CAMPFIRE POTATO PACKETS\*

1 HOUR BEFORE  
THE TURKEY'S DONE



# HOW TO CUT ANYTHING

An enormously important skill you can't afford to do poorly.

**YOU CAN'T UNCUT SOMETHING.** You have to do it right the first time, or you have to go and buy a replacement. Learn to skilfully apply a blade, though, and every single one of your projects will turn out better. You'll have tighter joints, cleaner edges, and more enviable finished products. You'll save money, too. In that way, cutting skills are a lot like initiative. You're never going to get anything done without them.



## SHEET METAL

*Tools: aviation snips, such as those from Wiss; jigsaw; metal-cutting blade*

If your sheet metal is about 1 mm thickness or less, use a set of aviation snips. A basic set consists of three snips: one that cuts left curves, that cuts right curves, and another that can do either but cuts best in straight lines. Colour-coded handles help you identify which is which: red handles cut left, green handles cut right, and yellow handles are for straight cuts. Mark your cut line with a felt-tipped pen or a carbide scribe and shear along the line. For sheet metal thicker than about 1 mm, use a jigsaw and a metal-cutting blade rated for the correct thickness.



## CAST-IRON PIPE

*Tools: soil-pipe cutter, reciprocating saw*

There's a reason we use cast-iron pipe: it doesn't cut easily. Plumbers use a tool called a soil-pipe cutter that has a wrap-around chain. This chain grips the pipe, scores it, and then snaps it. You can rent one of these things at most home centres. If the pipe you need to cut is in a trench, which is common when remodelling, ask the rental place for an in-place soil-pipe cutter. Alternative: use a big reciprocating saw with a diamond-grit blade.



**SAFETY TIP**  
Like your eyeballs the way they are? Wear safety goggles.





# HOSE

**Tools: serrated pocket knife, plastic pipe and tubing cutter**

A pocket knife with a serrated blade works best, but for hose that has a stiff wall, you can also use a plastic pipe and tubing cutter. Inexpensive models are available.



# BRICK

Tools: mason's chisel,  
brick hammer

Bricklaying isn't so hard — it's a game of Tetris where all the shapes are rectangles. That is, until you get to a corner. To cut brick to fit, mark the cut line with a carpenter's pencil. Score each of the brick's sides by tapping a mason's chisel along the cut line with a brick hammer. Position the chisel's bevel so it faces the waste side of the cut so you don't chip the part you plan to use. To split the brick, stand it on its long, narrow edge, place the chisel in the scored groove, and give it a sharp blow. Knock off any nub with the brick hammer.



# TROUT

*Tools: kitchen shears, fillet knife. Or try a thin Japanese kitchen knife,*

*like Masahiro's one-sided 14-cm utility knife. Chef Dave Racicot uses it for everything. Don't cut the*

First, wash the fish. Then scrape it from the tail to the head with the back of your knife blade to remove the scales. From there Pacicot recommends cutting off the bony dorsal fin with

inside. Lay the fish down with the spine facing you and the head facing your non-dominant hand. Push on the fish's belly with the hand that's not holding the knife to give it some tension, and make one long incision along the spine, from behind the head to the tail. There should be a bit of a flap now. That's the top of the fillet. Carefully hold that flap in one hand and lay your knife flat against the bones, guiding it down the ribs until the fillet is off. Repeat on the other side, making the initial cut in reverse, from the tail to the head.

tail to the head.

Tools: glass cutter, straightedge

Using a T square as a guide, pull a glass cutter along your cut line to score the glass. Lift the glass and tap the ball end of the cutting tool under the cut line several times. Holding the glass firmly in both hands, fold both sides down gently but firmly. It should break neatly in two.

**THINGS YOU COULD CUT BUT SHOULD PROBABLY LEAVE TO PROFESSIONALS:** Your own hair, keys, puffer fish, your dog's nails, diamonds, power lines, that tree with the branch that's directly over your living room.



# Don't know what to give?



We have a powerful gift loaded with possibilities.



Get to Builders. **Get it done!**

For your nearest store call our Builders Contact Centre  
on 0860 284 533 or visit us at [www.builders.co.za](http://www.builders.co.za)





# A TABLE FOR EVERYONE

Farmhouse furniture is meant to be a little imperfect. That makes it hard to screw up.

T

There's no better way to give thanks than to gather family and friends around an enormous table to share a feast. And if you're grilling your entire Christmas dinner the way we recommend elsewhere in this issue, you'll need somewhere to put all that food. A farmhouse table would be the perfect spot. You could make one out of construction timber and ordinary hardware in a couple of days. We're not talking precision woodworking here. If you can handle a circular saw and a chisel, you can do this. Farmers used to build these tables themselves, not furniture makers or carpenters, so it's okay if it turns out a bit rustic. That's half the fun. The other half is sitting down to eat at a table you built yourself.

## MATERIALS

| PART | DESCRIPTION     | QTY | TIMBER    | LENGTH |
|------|-----------------|-----|-----------|--------|
| A    | Tabletop piece  | 3   | 50 x 300  | 625    |
| B    | Breadboard end  | 2   | 50 x 150  | 86     |
| C    | Leg             | 4   | 100 x 100 | 724    |
| D    | Short stretcher | 2   | 100 x 100 | 660    |
| E    | Long stretcher  | 1   | 50 x 100  | 1 435  |
| F    | Short apron     | 2   | 50 x 100  | 476    |
| G    | Long apron      | 2   | 50 x 100  | 1 245  |

### TIP

When buying timber for furniture, even if it's construction-grade, you may have to cut the best piece from a larger hunk of wood. After you choose the timber from the stack, use chalk to mark the outline of the board you want. Then remove the excess. Yes, this results in more waste, but your finished product will look better for it.



## STEP 1

### PREP YOUR TIMBER

**C** Construction timber has a higher moisture content than the wood used to build furniture, so after purchasing it, let it sit around inside your house for several weeks to dry out a little.

To start, you'll want to cut out the pieces. Crosscut the top pieces, breadboard ends, stretchers, and legs. Note that the breadboard ends are slightly wider than the tabletop. This is a rustic detail with a practical aspect. It will allow the top to expand and contract with humidity and never be wider than the breadboard ends. There is also a slight overhang on the stretchers, for a similar reason. When you cut the legs, double-check that the length is a good fit for your dining-room chairs, especially if any of them have arms. Chairs with arms should be able to easily slide under the table's aprons.

Crosscut both short aprons but don't cut the long aprons yet. You'll measure those after joining the legs and stretchers.



Fig. 1  
Boring pocket holes

## STEP 2

### CREATE THE BASE

**T** To start, make a base assembly out of the aprons, legs, and stretchers. Attach one leg on either side of one of the short aprons. Bore two holes for pocket screws into each side of the apron's back, four in total (Fig. 1). Clamp the legs to the apron, but add a 3-mm piece of wood to the front as a spacer (Fig. 2). This will offset the face of the apron from the face of the leg, pushing it back a bit and creating a nice dimensionality. Drive the pocket screws through the apron into the leg. Repeat the same procedure for the second leg-apron assembly.

You're going to connect the two leg-apron assemblies to the stretchers using cross lap joints. These are among the easiest and most forgiving of wood joints to make, and they're also quite sturdy.

Mark the joint positions on the legs and stretchers. Start the half-lap joints on the legs by notching the two outside lines with a circular saw set to a depth of 40 mm. Guide the saw using a triangular rafter square. Between the two outside cuts,

make a series of relief cuts spaced 3 mm apart (Fig. 3). Then use a sharp chisel to chop away the waste (Fig. 4).

When you cut the half-lap joints on the short stretcher, set the saw's depth to 35 mm deep. This will make the stretcher extend 16 mm past the surface of the leg when the table is finally assembled. The offset will give you a table that looks like it was built by a farmer rather than by an up-market home décor store. It'll look nice.

Before connecting the pieces, follow the same procedure to cut an 89 mm-wide x 35 mm-deep notch in the middle of each short stretcher. This is where the long stretcher will sit.

Spread glue on the notched face of the short stretcher and the notched face of the leg, and press the pieces together. Make a counterbored hole through the leg's back and into the stretcher. Drive a 63-mm coarse-thread pocket screw through the leg into the stretcher to lock the pieces together. To hide the hole, glue a dowel into it, trim it flush with a chisel, and sand it smooth.

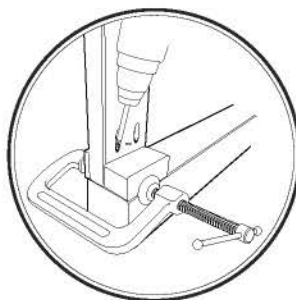


Fig. 2  
Using a spacer

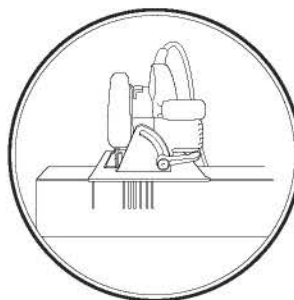


Fig. 3  
Making relief cuts

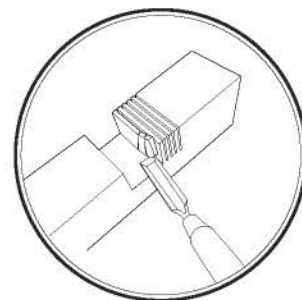


Fig. 4  
Finishing a half-lap joint



STEP 3

SKILL OF THE MONTH

# ASSEMBLE

**G** Glue the long stretcher into its notches on the short stretchers, and check that the two leg sub-assemblies are standing square to it. Counterbore screw holes in the long stretcher's end, and drive the screws to fasten it. Now measure and crosscut the long aprons. Join the long aprons to the leg subassemblies using pocket screws.

To make the top, align the three pieces of 50 x 300. Fit them as tightly together as you can. Bore four pocket-screw holes through the bottom faces of the top pieces, then spread glue on each adjoining edge. With the pieces clamped together so that the ends are flush, fasten with 63-mm pocket screws. Glue will squeeze out of the joint. Wait a few minutes for the glue to get rubbery, then shave it off with a sharp chisel. Keep the top flat as it dries – I like to clamp cauls across both ends to add stability. Cauls are 50 x 100 mm planks or other pieces of stout wood turned on their edges.

It's important that the ends of the top are straight and square. If the top shifts as the

glue dries, trim it with a saw, using the breadboard ends as a guide.

Use a dowelling jig to bore holes in the ends of the tabletop and on one side of each breadboard ends, spread a little glue on the dowels and attach the ends, using three ratchet-strap clamps to apply pressure as the glue dries.

Next, use right-angle brackets to mount the tabletop to the base. Elongate the bracket holes in the top a bit to allow for the wood to expand and contract with changes in humidity.

Sand the table smooth. Start with 80-grit paper, and move to a finer grit for each pass. You should end with 220-grit. I finished the table with two coats of Jacobean-tinted polyurethane. After it was dry, I buffed on a couple of coats of wax. The dark tint hides any scratches or nicks and also makes it look like it was built a century ago. On that note, you can give up your coasters – a little wear will only make your table look better.

## HOW TO CUT A POST

If you have a 250 mm mitre saw, you can chop 100 x 100 posts to the required length in a single cut. If you have a smaller saw or a circular saw, you'll need to make several passes. Use a rafter square to mark a cut line around all four sides of your wood. Place a 36 or 40-tooth blade in your circular saw, then make your first cut a little more than halfway through the wood. Rotate the timber towards you 90 degrees, and use the first cut to start your next one. Continue around the wood until you've sliced through. As you finish, support the waste piece so it doesn't break away unevenly and give you a jagged edge.

### FINISH IT

Chairs don't match your new table? Try one of these ProNature eco-friendly wood finish colours.



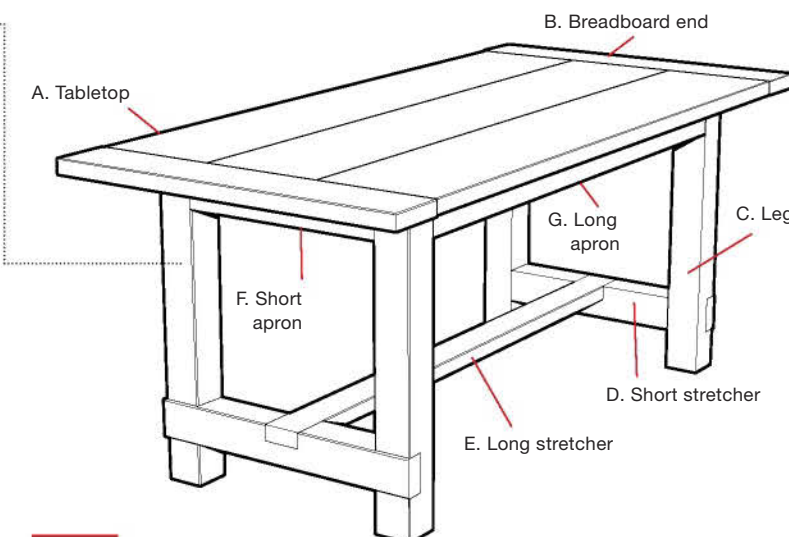
Light Brown



Dark Brown



Mid Brown



### TIP

If you like our table, but want something that looks a little more polished, just expand the finishing step. Start by sanding carefully and thoroughly, then apply a pre-stain wood conditioner. This will highlight the wood's grain and prevent the stain from absorbing unevenly. Apply your chosen finish in thin coats, carefully sanding out each coat and removing the sanding dust with a tack cloth before applying the next one. Finish the table with a coat of wax. There, now it's shiny.



# GREASE STAINS AND A PROBLEMATIC PAINT JOB

POPULAR MECHANICS' senior home editor can fix pretty much anything. Even that.  
By ROY BERENDSOHN



**I bought a top-quality roller for a paint job, but it looks lousy because fibre from the roller are trapped in the paint. What's with that?**

Even a good roller can shed fibres into your paint and make your wall look mangy. Try running some masking tape over the roller to remove any loose fibres, or rinse and dry your tools thoroughly before painting. And, of course, never use a low-quality paint roller. The situation can only get worse from here.

**The kid knocked a bucket of fried chicken onto the carpet. Nothing we've tried can take the stain out. Suggestions?**

Grease is tough stuff. Getting it out requires an alkaline cleaner, a solvent, or both. Start with an alkaline cleaner. I've removed grease stains by first adding a generous amount of Murphy Oil Soap (sadly, not apparently available in South Africa) and then gently rubbing in some borax until it forms a paste. I let that set and then wash the area. It works well, but it's messy.

If cleaning doesn't remove the stain, dissolving it with dry-cleaning fluid might. Most laymen don't know that you can buy it, but you can get it at hardware stores. Apply liberally and then blot with a paper towel. Test it on an inconspicuous area first.

**I repaired a damaged corner on a newel post in our home with wood filler. I sanded the patched area, painted it, and it looked great. Then the filler cracked. Now what?**

Big globs of wood filler can shrink as they dry and release their solvent into the atmosphere. This leads to cracking. To reduce the chances of this happening in the future, let's review the basics:

- Use the right filler. The container will tell you if the material is designed for inside use, outside use, or both.
- Proportion two-part fillers correctly and mix them thoroughly. When the two parts have blended to a single colour, the filler is ready. Mix only enough to use in a short amount of time. Fifteen minutes, say.
- Always use the least amount of filler for any given repair.
- Apply the filler in thin layers, and allow each to dry before proceeding.

As for your cracked post, you'll want to dig out the wood filler with a chisel and form a replacement piece out of wood. Glue and then nail it on. Apply filler, if needed, to blend in the repair. Finally, sand the repaired area smooth, prime, and paint.

ONE-STEP GUIDE TO DEFUZZING A PAINT ROLLER: Run a piece of tape over it. Also works on jackets.



# BUYER'S GUIDE

To advertise in Buyer's Guide contact Joanne, Lindi or Patrick on 011 449 1100 or email: [popbuyersguide@ramsaymedia.co.za](mailto:popbuyersguide@ramsaymedia.co.za)



**Autostyle Motorsport**

**Autostyle Gauteng**  
83a Church Street, Mayfair, JHB, Gauteng  
Tel: 011 661 1700  
Fax: 011 837 3116

**Autostyle Kwazulu-Natal**  
1-3 Jubilee Grove, Gateway Autocity  
Umhlanga-Ridge, Kwazulu-Natal  
Tel: 031 566 5099  
Fax: 031 566 3473



**Original Plasti-Dip Range of Liquid Vinyl Sprays & Paints - from R150**

**NATIONWIDE DELIVERY! OPEN 7 DAYS! WE BEAT ANY PRICE!**

VISA   MasterCard   American Express   Euronet   Credit

**WWW.AUTOSTYLE.CO.ZA**

|                                                                                                                                                                                                  |                                                                                                                                                                                                                 |                                                                                                                                                                                               |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><b>OSRAM</b><br/>Silver Star Bulbs<br/>50% Brighter, 20m More Distance. From R95set</p>                     |  <p><b>Xenon HID Headlight Kits</b><br/>H1, H7, H3 &amp; H4 from R495set<br/>Philips HID Kits Now Available from R1195set</p>  |  <p><b>Carbon Shields</b><br/>Bonnet Guard - R275<br/>Headlight Shields - R240<br/>Windshields - R190set</p> |  <p><b>Assorted DRL Style LED Headlights</b> from R1395set</p>                                                                                                     |  <p><b>Lamin-X Films</b> 60x30cm<br/>Assorted Colors - R195ea<br/>Custom Sizes can be cut</p>                                                                                         |  <p><b>Auto Gauge</b><br/>Assorted Design Autogauge<br/>Performance Gauges<br/>Boost Gauge - from R180<br/>Oil Pressure - from R180<br/>Oil Temp. - from R180<br/>Tachmetres, Shiftlights and many more available</p> |
|  <p><b>Bodykits and Spoilers</b><br/>Available for most cars</p>                                                |  <p><b>Non Reclinable Racing Seats</b> R850ea<br/><br/>Reclinable Racing Seats including Rails Exclusive Design! R2395pair</p> |  <p><b>Evo 3 Bike Carrier</b> R495<br/>Thule Range Now In Stock!</p>                                         |  <p><b>Cobra ESD-7570 Laser &amp; Radar Detector</b> - R850</p>                                                                                                    |  <p><b>Duplicolor Interior Vinyl &amp; Fabric Spray</b> R90</p>                                                                                                                       |  <p><b>RaceChip</b><br/>RaceChip Upgrade Chip<br/>30% More Power! 26% More Torque!<br/>Up to 1l/100km fuel less consumption!<br/>RaceChip I - R3350<br/>RaceChip Pro 2 - R4350<br/>RaceChip Ultimate - R6350</p>      |
|  <p><b>Starsound Media Player</b><br/>with USB &amp; Front Aux R450</p>                                         |  <p><b>Pioneer DEH-155MP</b><br/>Front Loader with Front Auxillary input R650</p>                                              |  <p><b>Nexvox Id705 DVD</b> with 7" Screen &amp; USB - R1895</p>                                  |  <p><b>Sony CDX-GT1051u Mp3</b><br/>Front Loader with USB "Carbon Design" R795</p>                                                                                 |  <p><b>Solid Audio DVD/Mp3 Cd</b><br/>Front Loader with USB &amp; Front Aux R750</p>                                                                                                  |  <p><b>JVC KW-R400 Double Din</b><br/>Mp3 + USB R1450</p>                                                                                                                                                             |
|  <p><b>Targa Amplifiers</b><br/>1500w 2channel - R495<br/>3000w 4channel - R695<br/>5000w 4channel - R995</p> |  <p><b>Starsound Double Din</b><br/>DVD &amp; GPS R2400</p>                                                                  |  <p><b>Pioneer</b><br/>12" 1000w - R495<br/>12" 1400w - R550<br/>12" 1400w DVC - R595</p> |  <p><b>Roofmount Screens</b><br/>7" - R795<br/>8.5" - R850<br/>13" - R1295<br/>12" - R1095<br/>15.4" - R1695<br/>17" - R2100<br/>19" - R2800<br/>22" - R2995</p> |  <p><b>STARTING GRID Audio Combo</b><br/>Includes:<br/>3000w 4ch Amp,<br/>12" 1200w Subwoofer<br/>+ 12" Sub Enclosure<br/>+ 300w Tweeters<br/>+ 600w 6x9" Speakers<br/>R1095set</p> |  <p><b>Evo Altus Alloy Wheels</b><br/>4/100 &amp; 4/108 pcd<br/>14" R2495   17" R3995</p>                                                                                                                           |
|  <p><b>Evo Falcon Alloy Wheels</b><br/>4/100, 4/108 &amp; 4/114pcd<br/>15" R2895   17" R4195</p>              |  <p><b>Edition35 Alloys</b><br/>17" R4395<br/>18" R4995   19" R5500</p>                                                      |  <p><b>Evo Catania Alloys</b><br/>4/100 &amp; 4/114 pcd<br/>15" R3095   17" R3995</p>                      |  <p><b>Evo Fida Alloy Wheels</b><br/>4/100 &amp; 5/100pcd<br/>15" R2895   17" R3800</p>                                                                          |  <p><b>20" Evo Taurus Alloys</b><br/>6x139pcd<br/>R9800 set of 4</p>                                                                                    |                                                                                                                                                                                                                     |

**DUNLOP YOKOHAMA PIRELLI WANLI accelera KENDA EVO**

**WHEEL & TYRE FITMENT CENTRE OPEN SEVEN DAYS!**  
Opposite Autostyle JHB Store.  
ALLOY WHEEL & TYRE FITTING, BALANCING, STRIPPING

ALL OUR ALLOY WHEELS ARE SUPPLIED "COMPLETE" INCLUDES BOLTS, NUTS, SPIGOTS, CENTER CAPS, VALVES AND VALVE CAPS

|                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>13 &amp; 14" TYRES</b></p> <p>155/70/13" - Dunlop - R450<br/>155/80/13" - Dunlop - R420<br/>175/50/13" - Yokohama - R850<br/>175/70/13" - Dunlop - R450<br/>165/80/13" - Sava - R380</p> <p>175/65/14" - Dunlop - R480<br/>175/65/14" - Pirelli - R595<br/>175/70/14" - Kenda - R590<br/>185/60/14" - Dunlop - R530<br/>185/60/14" - Pirelli - R650<br/>185/65/14" - Dunlop - R540<br/>185/65/15" - Kenda - R540</p> | <p><b>15 &amp; 16" TYRES</b></p> <p>185/65/15" - Dunlop - R660<br/>195/50/15" - Kenda - R550<br/>195/50/15" - Dunlop - R620<br/>195/50/15" - Pirelli - R795<br/>195/50/15" - Yokohama - R680<br/>195/55/15" - Dunlop - R730<br/>195/60/15" - Pirelli - R820<br/>195/60/15" - Dunlop - R670<br/>195/65/15" - Dunlop - R640<br/>205/60/15" - Dunlop - R730</p> <p>195/45/16" - Wanli - R800<br/>205/55/16" - Yokohama - R795<br/>205/55/16" - Dunlop - R780<br/>225/55/16" - Dunlop - R980</p> | <p><b>17" &amp; 18" TYRES</b></p> <p>205/45/16" - Kenda - R740<br/>205/40/17" - Wanli - R620<br/>205/40/17" - Dunlop - R695<br/>205/40/17" - Pirelli - R995<br/>205/40/17" - Yokohama - R995<br/>215/45/17" - Kenda - R780<br/>225/45/17" - Accelera - R950<br/>225/45/17" - Yokohama - R1150<br/>235/45/17" - Wanli - R850</p> <p>215/35/18" - Accelera - R980<br/>225/40/18" - Kenda - R895<br/>225/40/18" - Dunlop - R950<br/>225/40/18" - Yokohama - R1550<br/>235/40/18" - Accelera - R1450<br/>255/35/18" - Wanli - R1650</p> | <p><b>4x4, 19" &amp; 20"</b></p> <p>225/35/19" - Yokohama - R1795<br/>235/35/19" - Achilles - R1295<br/>235/35/19" - Yokohama - R1795<br/>265/30/19" - Accelera - R1900<br/>225/30/20" - Accelera - R2100</p> <p><b>Bakkie and 4x4/SUV Tyres</b><br/>195R14" - Dunlop - R820<br/>215/R15" - Dunlop - R1050<br/>195R15C - Dunlop - R1050<br/>235/65/17" - Wanli - R1295<br/>275/40/20" - Sunny - R1450<br/>275/45/20" - Zeta - R1850</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

E&OE All prices are Vat inclusive. Prices are valid at time of print. ©All images & logos are copyright property of Autostyle Motorsport & their respective suppliers



# BUYER'S GUIDE

To advertise in Buyer's Guide contact Joanne, Lindi or Patrick on 011 449 1100 or email: [popbuyersguide@ramsaymedia.co.za](mailto:popbuyersguide@ramsaymedia.co.za)

**FINANCE AVAILABLE**

F5P31528



**THE BEST VW RADIO REPLACEMENT**



**MOBILE** **NAVIGATION** **MUSIC**

**GOLF 7 INCREASE BY 2.2 INCHES**



**5.8" monitor** **8" TFT LCD monitor**

**DIRECT IMPORTERS**

**FROM R5999** incl. installation  
1 year warranty  
and latest version of South African maps



**AND DVD GPS UNITS AVAILABLE FOR MOST POPULAR VEHICLE BRANDS**



**TEL: 011 609 6178**  
**WWW.CARDVDGPS.CO.ZA**  
**INFO@CARDVDGPS.CO.ZA**  
**97 VAN RIEBEECK AVE, EDENVALE**

**XENON/HID LIGHTS**  
INCLUDES FREE INSTALLATION AND ONE YEAR WARRANTY



**COMPATIBLE WITH ALL THE LATEST MODELS**  
CONVERSION KITS AVAILABLE FOR ALL CARS & BIKES

**BUY NOW AND GET: FREE INSTALLATION, ONE YEAR WARRANTY & FREE SHIPPING WITHIN SA**

**PCUT Vinyl Cutter**

Incl. Software & Stand  
330mm R5500 incl vat  
630mm R8000 incl vat  
1260mm R12500 incl vat

Incl PEN & BLADE

Voted No.1 Imported in Europe / USA

Make Vehicle Signage  
SandBlast Glass & Tombstones & Letters  
For Sportswear. Also Draw Plans & Templates

print underwear, caps, bags. **Cap Press R3000 incl vat**  
print plates. **Plate Press R3000 incl vat**  
print mugs, waterbottles **Mug Press R3200 incl vat**  
Cone & Regular mugs

**T-Shirt Heat Press**  
38x38cm R3500 incl  
40x60cm R5000 incl

Put Pictures onto  
T-Shirts, Pillowcases, Flags  
Tiles, Satin Ribbons etc

**5 in 1 Combo Press R8000 incl vat**

**R8500 Combo.**  
Pcut 330 + HeatPress 38x38cm = Soccer Kits

**Local Agents /Distributors /Resellers Wanted**

**www.vinylcutters.co.za 0313016230 Country-Wide Delivery**

**CFP TECHNOLOGIES**

*Electric motors & Drives*  
Speed Control for your Machinery,  
Pumps, Conveyors, Fans, Mixers, etc

Variable Speed Drives for Electric Motors (VFD's or VSD's)  
Single phase input, three phase output models. 0.18 Kw - 4 Kw  
Three phase input, three phase output models. 0.18 Kw - 1000 Kw

**Electric Motors**  
Single Phase: 0.12 Kw - 7.5 Kw Three Phase: 0.18 Kw - 330 Kw



**Website: [www.cfptech.co.za](http://www.cfptech.co.za)**  
**Email: [cjvdb@mweb.co.za](mailto:cjvdb@mweb.co.za)**  
**Tel: 082 8570324**

**MOLDABLE PLASTIC**

**InstaForm®**

USES:  
•Rapid prototyping. •Fabrication of mechanical parts for models. •Specialised components eg motor mountings. •Joining components together. •Mouldings for handles & orthopaedic aids. •Vacuum forming moulds. •Can be pressed into sheets and rolled into rods. •Small scale modelling. •Repairing of plastic objects. •Mouldable at just 62°C.



**Direct and Wholesale Pricing Available**  
Email: [stevenmarx@vodamail.co.za](mailto:stevenmarx@vodamail.co.za)  
Cell: 082 9688 566

**YouTube** <https://www.youtube.com/watch?v=Rbp97TmoC4M&feature=youtu.be>

**CCTV Systems**

**From R1799**



**View your home on your Smartphone anywhere in the world.**

**info@cctv-direct.co.za**

**www.cctv-direct.co.za**

**ECOTRAX**

**Bicycle Engine Kit**

CONVERT YOUR BICYCLE INTO A RELIABLE AND ECONOMICAL MOTORCYCLE



• CLUTCH START  
• 48CC 2 STROKE ENGINE  
• 2LT/100KM FUEL ECONOMY  
• 50KM/H TOP SPEED

**INFO@ECOTRAX.BIZ**  
**WWW.ECOTRAX.BIZ**  
**082 376 1746**



**THE Ultimate CHOICE**

**PEOPLE WHO LOVE CARS. LOVE MEGUIAR'S**

*"Nothing creates a shine quite like Meguiar's"*  
Grant Harrison

**Meguiar's**  
since 1901

Products available from leading stockists countrywide

Join the fan club MeguiarsSA

See more, shop online or join our forum on: [www.keizin.co.za](http://www.keizin.co.za)  
Tel: 0861 CAR GUY [227489] Email: [info@meguiars.co.za](mailto:info@meguiars.co.za)

**KEIZIN**  
AUTOMOTIVE  
your advantage in car care

Alisa Di Felice Photography



## MULTI-SHARP® Drill Bit Sharpener

Correctly sharpens blunt and even broken drill bits in minutes! It's easy to use and accurate because the grinding jig has all the angles for correct tip geometry built in.

The aluminium oxide and silicon carbide wheels will sharpen at least 150 HSS bits, and 75 Masonry bits, based on 7/16" dia (6.5mm) - replacement wheels available

Guide to set HSS drill precisely



### HSS DRILL BITS



Drill Jig accurately positions drill bit over the Aluminium Oxide wheel. Unique cam action exactly reproduces correct tip geometry in a simple hand movement. Sharp, accurate new cutting edges in minutes, even on HSS bits coated or alloyed with hard metal e.g. cobalt.



### MASONRY DRILL BITS



Drill Jig accurately positions drill bit over Silicon Carbide wheel to give correct tip geometry. Sharpens all masonry drills - conventional 2-edged bits (15° relief angle), 4-edged hammer bits (30° relief angle), and the latest SDS-Plus bits.



### CENTRE POINT & FLAT WOOD BITS



The special geometry of this attachment enables accurate re-sharpening of centre-point wood bits on the aluminium oxide wheel.

The flat side of the wheel enables easy reshaping of flat wood bits.

**Vermont Sales**  
SOUTH AFRICA'S #1 SUPPLIER (Pty) Ltd  
of power tool accessories  
**Powered by Service**  
For your nearest dealer call us on 011 314 7711  
[www.vermontsales.co.za](http://www.vermontsales.co.za)

## GUTTER NO CLUTTER

Foam insert that allows water to flow through. Leaves and debris blow away.

- Easy to install foam insert
- Fits all common 5" half-round and extruded gutters
- Assists with mosquito control
- Prevents plant growth
- Ideal for harvesting rain water



For more information  
call Gutter No Clutter  
+27 76 470 4447

**KNIPEX**  
www.knipex.com

PREMIUM QUALITY  
PLIERS, CRIMPERS  
& TOOLS SINCE 1882

**wiha**  
www.wiha.com

PREMIUM QUALITY  
SCREWDRIVERS  
& HEX KEYS SINCE 1939

**RENNSTEIG TOOLS**  
www.rennsteig.com

PREMIUM QUALITY  
CHISELS, PUNCHES  
& SDS BITS

**EXECUTIVE**  
PREMIUM QUALITY  
TOOLKITS

**IREGA**  
www.irega.es

PREMIUM QUALITY  
SHIFTING  
SPANNERS



**ALL NEW**

## PowerBox & PedalBox

**The best way to optimise your vehicles performance**

Our performance systems are always at the cutting edge of quality, form & function.

The new **PowerBox & PedalBox** are supplied as complete systems with vehicle-specific software and OEM quality adapter looms.

Detailed, illustrated instructions are provided to assist with the simple, plug-in, installation.

**ORDER NOW**

### 021 556 6463

**PowerBox & PedalBox by DIESEL TORQUE**  
 Phone 082 379 6141 or 083 298 8544  
 Mail [info@dieseltorque.co.za](mailto:info@dieseltorque.co.za)  
 Web [www.dieseltorque.co.za](http://www.dieseltorque.co.za)  
[www.pedalbox.co.za](http://www.pedalbox.co.za)

**BETTER POWER OUTPUT**

**MAXIMUM PERFORMANCE**

**CONSUMPTION OPTIMISATION**

up to **30% more POWER**

up to **20% less FUEL**

**Get the latest technology NOW!**

- > Surface mounted Keypad ✓
- > Ultra-High-Speed-Processor ✓
- > Multi-Map-Technology ✓

- > Lifetime Warranty ✓
- > Simple Plug-in Installation ✓
- > Made in Germany ✓

|                                                                                                                        |                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>PowerBox for Cars</b></p> <p>Turbo Diesel from R1995</p> <p>Turbo Petrol from R3995</p> <p>Petrol from R2995</p> | <p><b>PowerBox for Trucks</b></p> <p>Turbo Diesel from R4995</p> <p><b>PowerBox for Tractor</b></p> <p>Turbo Diesel from R4995</p> |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|

**PedalBox for Cars, SUVs, Vans, Trucks...**  
 Diesel & Petrol from R2250



# CNC CLEAR CUT

## CNC PLASMA CUTTING TABLES

**WORKSHOP CNC PLASMA CUTTER**

### R228,000

EXCL.

Quote magazine and receive a NestMaster to the value of **R23 000** free with machine.



**FEATURES**

- 2.5m x 1.3m sheet size
- Pierce Capability of 10mm
- Magnetic torch breakaway
- Auto Torch High Control
- Water Bed

Training, support, service and consumables readily available.  
 Contact us for our Industrial HI definition systems up to and over 12 x 2.5 meters; 50mm cutting thickness.

**South Africa's Leading CNC Plasma Table Manufacturer**



Tel: +27 12 541 0552  
 e-mail: [enquiries@cncclearcut.co.za](mailto:enquiries@cncclearcut.co.za)  
[www.cncclearcut.co.za](http://www.cncclearcut.co.za)





**BesTech**  
Since 1983

Quality • Safety • Comfort

**Rearview Mirror Cameras**



- Protect your loved ones
- Reversing and parking made easy
- Prevent costly damage

**Hands-Free Car Kits**




- The driver's attention is not distracted
- User friendly
- Drive and talk without the risk of fines

**Park Distance Control**



- Protect your loved ones
- Prevent costly damage
- Reversing and parking made easy

**Cruise Control**



- Reduce driving stress
- Improve fuel economy
- Avoid unintended speeding fines

**Electric Windows**



- No more winding or stretching to reach window winder handles
- Universal and Factory replacement type available
- Close windows quickly at the touch of a button

Tel: 0861 220 220 • [www.bestech.co.za](http://www.bestech.co.za)

**A NEW WINDOW TO THE WORLD OF**

# Gaskets

- PREMIUM QUALITY (apprvd by C.A.E)
- COSWORTH TESTED (Burton Power U.K)
- REUSABLE with built in O-rings (no groove needed)
- ALUMINIUM/COPPER/STAINLESS STEEL
- SEALING PRESSURE up to 7 times MORE
- COMPRESSION RATIO raised or lowered
- LARGE BORE SIZES
- TURBO/NITROUS/ALCOHOL
- CUSTOM BUILT

**Contact: Redline Engineering**  
Tel: 021 556 5764 or 072 1433 773  
[www.redline-engineering.com](http://www.redline-engineering.com)



## SuperCycles

Convert your bicycle to a motor cycle

**AS SEEN ON TV**

Agents in: Cape Town, Durban, East London, Nelspruit, Port Elizabeth, Springbok, Swellendam, Worcester. Retailers wanted for other areas, visit [www.super-cycles.co.za](http://www.super-cycles.co.za)  
041 373 0797



Kits from **R2195.00**  
Performance kits from **R2495.00** SAVE **R395.00**  
Friction drive kits from **R1550.00**

**Ind. FREE DELIVERY!**



# PAR

**RUBBER & PLASTIC EXTRUSION & MOULDING**

Call **STEPHAN** on **082 418 8397**





## GoAerial



The Blade 350 QX is an affordable GoPro camera compatible quadcopter, utilizing GPS and barometric sensing to maintain position and altitude autonomously. Simply attach your GoPro camera and get the most amazing aerial video or still shots. This latest version has 4 different flight modes to suit your flying ability. No previous flying experience is required. Visit our website for details.

[www.goaerial.co.za](http://www.goaerial.co.za) / [info@goaerial.co.za](mailto:info@goaerial.co.za)  
076 701 1029

## RAPID PROTOTYPING by 3D Printing

Take your 2D design ideas and turn them into 3D reality.  
Convert what you can see into what you can hold.

### Liquid EDGE

2D 3D



[www.liquid-edge.co.za](http://www.liquid-edge.co.za)  
Marilyn: 072 460 1996

# Automate your site

**The GSM Commander turns:**

- Your farm into a factory,
- Your phone into a control panel,
- Your nightmares into sweet dreams...



**Secure** your home  
**Monitor** tanks  
**Control** pumps, pivots  
**Detect** cable theft  
**Protect** solar panels  
**Notify** you of events  
- and so much more...

The GSM Commander uses a standard SIM card to communicate to your phone or to the internet. It uses the award-winning SmartSetup® software to allow it to do so much more than merely communicate...  
Call us with your unique problem, and we will invent a solution for you.



Developed and manufactured and supported in South Africa

Tel: +27 (0)21 9817062  
Email: [info@gsmcommander.com](mailto:info@gsmcommander.com)  
**WWW.GSMCOMMANDER.COM**








Additive Manufacturing Technology

## 3D Solids Additive Manufacturing Technology

Stratasys Designated Gold Partner - 2014

At the core : Advanced FDM (Fused Deposition Modeling) Technology  
Now produce usable parts in high strength engineering thermoplastics



**Dimension Elite** : Most versatile 3D Printer - Prints in Fine & Standard Resolution.

**uPrint SE Plus** : Easy to use and easy on your budget.

**Dimension SST1200es** : Builds large, functional durable 3D models from your 3D CAD files.

Contact us for detailed information :  
Russell Oosterlaak  
Tel : 012 345 5112  
Email : [margie@3dsolids.co.za](mailto:margie@3dsolids.co.za)



Dimension Family



Fortus Family

**Fortus 250mc** : Professional-grade System - at an affordable price : Prints in Fine, Standard & Draft Resolution.

**Fortus 400mc & 900mc** : Both Manufacture real parts in a wide range of thermoplastics - ABS-M30; PC; PPSF; Ultem 9085; PC-ABS and more.

[www.3dsolids.co.za](http://www.3dsolids.co.za)

Exclusive Stratasys Certified System Engineers for all Fortus and Dimension 3D Systems



## FORCE PROFESSIONAL TOOLS

144 Nolte Road  
Bartlett  
Boksburg  
1459

Tel: 0861 1FORCE

011 826 0024

Fax: 086 771 4058

Email: [showroom@forcetools.co.za](mailto:showroom@forcetools.co.za)

facebook.com/ForceTools @ForceTools

Visit Our  
Showroom  
Today

### 74pc 1/4" DR Socket Combination Set



**R1150**

6pt. Flank socket 4; 4.5; 5; 5.5; 6; 7; 8; 9;  
10; 11; 12; 13mm  
6pt. Flank deep socket 4; 4.5; 5; 5.5; 6; 7;  
8; 9; 10; 11; 12; 13mm  
Star socket E4; E5; E6; E7; E8; E10  
Star deep socket E4; E5; E6; E7; E8; E10  
Socket bit (32mmL):  
Hex 3; 4; 5; 6; 7; 8; 10 mm  
Phillips PH.0; PH.1; PH.2  
Pozidriv PZ.0; PZ.1; PZ.2  
Slotted 4; 5.5; 7 mm  
Star T8; T10; T15; T20; T25; T27; T30; T40  
Star tamperproof T-8H; T-10H; T-15H; T-20H;  
T-25H; T-27H; T-30H; T-40H  
Flexible ratchet  
Extension bar 2"; 4"; 6"  
Universal joint  
Magnetic socket pick-up

Wishing all our Valued Customers  
A Merry Christmas  
And a Happy New Year

### Our Christmas Special 101pc Layer Toolbox

50235-101

Foam Set:  
Locking Pliers 10  
1/2" Drive Ratchet Handle 24 teeth  
1/2" DR Universal Joint  
1/2" Extension 125mmL 5  
1/2" Extension 250mmL 10  
Ball Pein Hammer 24oz

1/2" Spark Plug Socket 20.6

1/2" 12pt Flank Socket:  
8; 10; 11; 12; 13; 14; 15; 16;  
17; 18; 19; 21; 22; 23; 26

Combination wrench:  
8; 10; 11; 12; 13; 14; 15; 16;  
17; 18; 19; 21; 22; 23; 24mm

Save  
**R955**

Screwdrivers:  
Phillips PH.0 (135mm)  
Phillips PH.1 (180mm)  
Phillips PH.2 (215mm)  
Stubby Phillips PH.1 (75mm)  
Stubby Phillips PH.2 (75mm)  
Slotted 3mm (145mm)  
Slotted 4mm (175mm)  
Slotted 5.5mm (225mm)  
Slotted tip 6.5mm (265mm)  
Stubby Slotted 5.5mm (75mm)  
Stubby Slotted tip 6.5mm (75mm)

Pliers:  
Waterpump pliers 10"  
Long nose pliers 8"  
Combination pliers 7"  
Diagonal pliers 7"

Hex key:  
1.27; 1.5; 2; 2.5; 3; 4; 5;  
6; 8; 10mm

was R3 950  
**Now Only  
R2995**  
while stocks last

Buy Online At [www.forcetools.co.za](http://www.forcetools.co.za)

### 8pc Mini Pliers Set

50814

**R850**

Round nose pliers 5"  
Flat nose pliers 5"  
Combination pliers 5"  
Ring nose pliers 5"  
Needle nose pliers 6"  
Bent nose pliers 6"  
Cutter pliers 6"  
Diagonal pliers 6"

### 16pc Jeweller Screwdriver Set

2742-18

**R855**

Slotted Jeweller Screwdriver 1.0; 1.2; 1.5; 1.8;  
2.0; 2.5mm  
Phillips Jeweller Screwdrivers PH.000; PH.00  
Hex Jeweller Screwdrivers 0.9; 1.3; 1.5mm  
Snake Nose Pliers  
Stocky Model Versatility  
Tweezer  
Scissors  
Scalpel (With 6 Blades)

### 12pc Midget Combination Wrench

K51214

**R495**

Midget combination wrench:  
8; 9; 10; 11; 12; 13; 14; 15; 16;  
17; 18; 19 mm



# BUYER'S GUIDE

To advertise in Buyer's Guide contact Joanne, Lindi or Patrick on 011 449 1100 or email: [popbuyersguide@ramsaymedia.co.za](mailto:popbuyersguide@ramsaymedia.co.za)

## TURBODOC

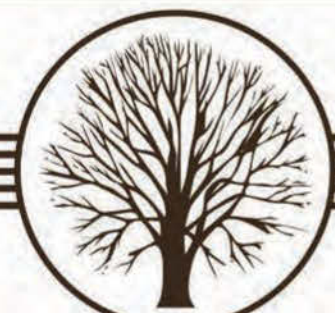


We specialise in re-manufacturing turbochargers with new centre cores and we also sell new and re-manufactured turbochargers. Service exchange units available for most vehicles.

27 Deysel Avenue, Strubensvale, Springs  
[www.turbodoc.co.za](http://www.turbodoc.co.za) | [mail@turbodoc.co.za](mailto:mail@turbodoc.co.za)  
 Tinus 081 300 9564 | Anna 083 941 7050  
 Fax: 0860 5999 48

**We pride ourselves in Fast and Honest service, at Affordable prices.**

*Soli Deo Gloria*



## TIMBERLINE

*woodcraft*  
 • est 1999 •



**All order sizes accommodated  
 Free delivery in Gauteng area**

**NOW CARRYING STOCK  
 OF IMPORTED FINNISH  
 BIRCH PLY**

- \* DURABLE
- \* ECO-FRIENDLY
- \* IDEAL FOR CNC WORK
- \* AESTHETICALLY PLEASING

**Contact:**  
 JP van Staden  
 Mobile: 0825588813  
 Email: [jp@timberline.co.za](mailto:jp@timberline.co.za)  
 Website: [www.timberline.co.za](http://www.timberline.co.za)

## SAF BAKKIE SPECIALISTS

**Service, Repairs & Maintenance  
 at Competitive Prices.**

**Major Services From R1999-00**

**PETROL & DIESEL**

- Toyota
- Ford / Mazda
- Isuzu KB Range
- Mitsubishi
- Nissan
- VW - Amarok

**AVAILABLE AT ALL SAC WORKSHOPS COUNTRY WIDE.**

|                         |                              |
|-------------------------|------------------------------|
| BOKSBURG: 011 823 3676  | KYALAMI: 011 466 2050        |
| CAPE TOWN: 021 552 1003 | NELSPRUIT: 013 753 3750      |
| CENTURION: 012 621 9060 | PORT ELIZABETH: 041 372 2301 |
| DURBAN: 031 569 6734    | VANDERBULPARK: 016 933 9972  |

SAC BLOEMFONTEIN WILL REOPEN SHORTLY UNDER NEW OWNERSHIP AND MANAGEMENT.  
[www.steves.co.za](http://www.steves.co.za)

## SMSALERT

A FULL ELECTRONICS PRODUCT

**SMS ALERT PORTABLE STAND-ALONE ALARM**

- PORTABLE ALARM SYSTEM
- SMS UP TO 4 CELLPHONES WHEN ALARM IS TRIGGERED
- ACTIVATES PEPPER GAS AND SIREN
- DIY, PLUGS IN AND READY FOR USE
- 2 BUTTON REMOTE (ARM/DISARM & PANIC)
- LISTEN-IN MICROPHONE
- MAINS POWER FAILURE & RECOVERY NOTIFICATION
- 6 HOUR BATTERY BACK-UP
- 1 OUTPUT EG. REMOTELY OPEN GATE OR TURN LIGHTS ON/OFF
- SOLAR PANEL INPUT
- EXPANDABLE OPTIONS

**R3995**

[hester@smsalert.co.za](mailto:hester@smsalert.co.za) 011 202 5884

**Upgrade to an electronic ignition...**

IGNITOR fits entirely inside the distributor - installs as quickly as changing a set of points! Add up to 20 horsepower



Fits 4, 6 & V8 engines From R790 incl VAT 30 month warranty

**SAVE PETROL**

**IGNITOR**  
 Never Change Points Again!  
[www.pertronix.com](http://www.pertronix.com)

CONTACT THE AUTHORISED SOUTHERN AFRICAN IMPORTERS  
**OFFSHORE MARINE INTERNATIONAL**

Tel/Fax (021) 786 1007  
 Cell 082 491 8536  
 E-Mail: [omint@omweb.co.za](mailto:omint@omweb.co.za)  
 P O BOX 43921 Fish Hoek 7974

**Get it on!**



## KANGO

Canopies & Linings

**Kango Canopies & Linings**  
 1 Eimco Street, Jetpark, Boksburg, Gauteng  
 Tel: (011) 397-7753 | Fax: (011) 397-7752  
 Cell: 082 894 1678 | [kangosales@iafrica.com](mailto:kangosales@iafrica.com)  
[www.kangocanopies.co.za](http://www.kangocanopies.co.za)

## MAKE 2014 YOUR YEAR!

WITH OUR WIDE RANGE OF PROFITABLE BUSINESS OPPORTUNITIES



**Novelty & Corporate Print Systems**

**Button Badges**

**Photo Quality Sandblasting & Crystal Decoration**

**Vinyl Cutter**

**24 Years in Business** Branches: JHB, BFN & CTN

[www.jgelectronics.com](http://www.jgelectronics.com)

SMS MUGGIT PM + your email address to 40840 (SMS costs R2.50)  
 or email us at [pm@jge.co.za](mailto:pm@jge.co.za) for a free catalogue | Tel 011 789 6033 | Fax 011 781 3065

**ELECTRONICS**



## TURN METAL INTO MONEY

**MAKE: RACE CARS • FURNITURE • TRAILERS • SECURITY DOORS • JUNGLE GYMS • FARM EQUIP**

**BEND & ROLL to 50 mm tube! Also Scrollers \* Twister \* Tube Notchers \* Brake Press \* Shear**

Multi Bend System



Improved Model For Easier Bending

Ring Rollers



Scrollers



Twister



Press



**STRONGMAN  
METAL TOOLS**  
[www.strongman.co.za](http://www.strongman.co.za)  
Units 5 & 8, Greenhouse, Cnr R23 & N3, Heidelberg

- > Delivered to your Door!
- > Built to Last
- > Easy to Use
- > Spares and Support

**PROJECT IDEAS  
AND INFORMATION**

[www.strongman.co.za](http://www.strongman.co.za)



**GET YOUR INFO PACK NOW!**

Call Andries on 083 327 9988  
SMS "PM" & your email address to 083 327 9988  
or Email [info@strongman.co.za](mailto:info@strongman.co.za)  
[strongmantools@gmail.com](mailto:strongmantools@gmail.com)  
Visit our Demo Centre in Heidelberg

**SPECIALISTS FOR LANDCRUISER, HILUX 4X4,  
QUANTUM, DYNA AND OTHER TOYOTA MODELS**



**"DIRECT" Importers of O.E. QUALITY replacements parts suitable for Toyota's**

# = Gemini Parts =

Tel: (011) 334-1417 | Fax: (011) 334-0069

[sales@geminiparts.co.za](mailto:sales@geminiparts.co.za) | [www.geminiparts.co.za](http://www.geminiparts.co.za)

P.O. Box 261048, EXCOM, 2023 - 16 Kruis Street, Johannesburg 2001





**CTX 3030**  
*The Future of Discovery*

The waterproof all-terrain CTX 3030 is the ultimate TREASURE detector.

**Contact MineLab South Africa**  
Zambesi Drive, Sinoville, Pretoria, South Africa.  
Tel: George +27 (0) 83 702 0312 or Quintin +27 (0) 82 319 3831 or Werner +27 (0) 82 2622 278  
Email: [info@minelab.co.za](mailto:info@minelab.co.za) Web: [www.minelab.co.za](http://www.minelab.co.za)

Adventure Detectors | Treasure Detectors | Gold Detectors

FBS 2 Smartfind 2 GPS+ WISDOM  
World's Best Metal Detection Technologies







# BUYER'S GUIDE

To advertise in Buyer's Guide contact Joanne, Lindi or Patrick on 011 449 1100 or email: [popbuyersguide@ramsaymedia.co.za](mailto:popbuyersguide@ramsaymedia.co.za)

**ARE YOU USING PROTECTION?**  
[www.flexishield.co.za](http://www.flexishield.co.za)



**Flexi Shield™**  
We've got you covered!

Since 1996  
Ask for it by name!

 <http://www.facebook.com/FlexiShield>

**Protect your vehicle from stone chips and sand blasting!**  
**Precut kits = No trimming on Vehicle**



**Head Office: (Vaal)**  
**We have Fitment Centers In The Following Areas:**

|           |           |
|-----------|-----------|
| Germiston | Pretoria  |
| Hazeldean | Namibia   |
| Randburg  | Cape Town |

**Phone Head Office**  
**For Your Nearest Fitment Centre**  
**016-421 3735**

**GS-911**  
Diagnostic Tool



**85grams**  
for peace of mind

**... or hope Hazziz doesn't miss his camel.**



A diagnostic tool for BMW motorcycles, with Windows PC, Windows Mobile, BlackBerry & Android support.

Read & clear fault codes, view real-time values (sensors & outputs), reset service reminders, etc. This is the ideal tool that should be in everyone's toolkit, for expeditions, enthusiasts & mechanics alike.

**Phone: 021 850 0650 | Online shop: [shop.hexdiagnostics.co.za](http://shop.hexdiagnostics.co.za)**

**OPEL & CHEV SPARES AT AFFORDABLE PRICES**

**LOPEC AUTO SPARES**

Like   @LopezAutoSpares



**Map:** N12 Highway, Boksburg, Anderbolt, Main Rd, Top Rd, Atlas Rd, Paul Smit Rd, Coming from Main Reef Road.

**Coordinates:** 26°11'38"S 28°16'18"E  
Unit 14, Middle Office Park, Top Road, Anderbolt Boksburg

**Contact:** [www.lopec.co.za](http://www.lopec.co.za), [sales@lopec.co.za](mailto:sales@lopec.co.za)  
T: 011 894 1322 / 011 894 5987  
F: 086 557 1717

## MULTI-SHARP® Drill Bit Sharpener

Correctly sharpens blunt and even broken drill bits in minutes! It's easy to use and accurate **because the grinding jig has all the angles for correct tip geometry built in.**

The aluminium oxide and silicon carbide wheels will sharpen at least 150 HSS bits and 75 Masonry bits, based on 1/4" dia (6.5mm) - replacement wheels available

Sharpen 3-13 mm (1/4"-1/2") dia. drills, covering 95% of the Do It Yourself market.

Guide to set HSS drill precisely

Grinding jig

Fits any power drill inc. cordless

Separate mounting - foot included, to hold MULTI-SHARP firmly to bench/worktop

### HSS DRILL BITS



Drill Jig accurately positions drill bit over the Aluminium Oxide wheel. Unique cam action exactly reproduces correct tip geometry in a simple hand movement. Sharp, accurate new cutting edges in minutes, even on HSS bits coated or alloyed with hard metal e.g. cobalt.

HSS TWIST

### MASONRY DRILL BITS



Drill Jig accurately positions drill bit over Silicon Carbide wheel to give correct tip geometry. Sharpens all masonry drills - conventional 2-edged bits (15° relief angle), 4-edged hammer bits (30° relief angle), and the latest SDS-Plus bits.

132° MASONRY 2 EDGE, 132° HAMMER 4 EDGE, 132° SDS-PLUS

### CENTRE POINT & FLAT WOOD BITS



The special geometry of this attachment enables accurate re-sharpening of centre-point wood bits on the aluminium oxide wheel.

The flat side of the wheel enables easy sharpening of flat wood bits.

CENTRE-POINT, FLAT WOOD BITS

## Vermont Sales

SOUTH AFRICA'S #1 SUPPLIER of power tool accessories (Pty) Ltd

**Powered by Service**

For your nearest dealer call us on 011 314 7711  
[www.vermontsales.co.za](http://www.vermontsales.co.za)

## SEE IT **ALL** THE TIME.

With our range of night vision devices, trail cameras and hand held searchlights, neither dark nor distance will keep you from keeping an eye on every detail. Proudly distributed by Lynx, you can be sure of the quality and quick local support that has become synonymous with our name.



### LIGHTFORCE CORDLESS ENFORCER\*

- 30-watt Xenophot bulb for primary illumination
- Low energy 3 LED task light
- 140 mm, 170 mm and 240 mm diameters
- Focus from a pencil beam to a spot

*\*Product may differ from picture*

### RANGER MOTION ACTIVATED CAMERAS

- Day & night (low glow IR flash available on some models)
- Photo / video
- SMS / e-mail notification<sup>1</sup>
- Up to 32 GB memory
- Weatherproof

<sup>1</sup>Available on all models, requires optional transmitter module

### xGEN DIGITAL NIGHT VISION VIEWER

- Up to 70 metres
- Compact and lightweight
- Infrared illuminator
- 3x - 6x magnification



Visit [www.lynx.co.za](http://www.lynx.co.za) or contact us for specifications and options.  
[info@lynx.co.za](mailto:info@lynx.co.za) • tel 011 792 6644 • fax 011 792 8923

**BE SURE TO LOOK INTO LYNX**



## Patent and Prototyping

- 3D CAD modelling
- Photorealistic posters
- 3D printing / CNC
- Patent and trademark searches
- Patents / Designs / Trademarks
- Online patent renewals
- Supply / Licence agreements

Fixed pricing for inventors  
+1,250 patents & designs filed



Patent attorneys, Product designers, Engineers

[www.ideanav.co.za](http://www.ideanav.co.za)  
[info@ideanav.co.za](mailto:info@ideanav.co.za)  
011 483 3128

## CANSONIC®

MORE THAN AN ACTION CAMERA  
(Full HD)



- CAN** Record full HD
- CAN** Time lapse automatically
- CAN** Detect motion and start recording
- CAN** Detect shock and start recording
- CAN** Record and playback Stereo
- CAN** Position on Google maps via GPS
- CAN** Show speed and G-forces
- CAN** Record continuously (loop)
- CAN** Record under water (30m)
- CAN** Connect via Wi-Fi to smartphone

## CANSONIC®



Feature for Feature, Rand for Rand ... Unbeatable

### Accessories (included)

- Handlebar mount kit
- Assorted helmet mounts
- 90° angle mount kit
- 12V cigarette lighter charger
- Waterproof or water resistant housing
- Suction cup
- USB cable
- GPS sensor
- 32GB SD CARD (13 hrs recording time)

0861 PLANET (752638)  
[info@planetron.co.za](mailto:info@planetron.co.za)  
[www.planetron.co.za](http://www.planetron.co.za)



Scan to buy



## VAN ACHT

Wooden Windows & Doors



Frameless Folding Doors  
Enclose your Patio!

Randburg, Kya Sand 011 708 2488 | Krugersdorp 011 664 7192 | Montana 012 548 7672  
Hartbeespoortdam 012 244 1319 | Klerksdorp 018 462 0784 |

f. 011 708 2023 | [sales@vanacht.co.za](mailto:sales@vanacht.co.za)  
[www.vanacht.co.za](http://www.vanacht.co.za)

## WINNING TIP

### FIX TOW PLUGS FOR GOOD

Our family does a lot of towing on and off the farm. Dust, dirt, mud and water get into the towing connections from both the front and rear of the male and female plug connectors. While removing the last lot ready for replacement, I was also doing some glue gun work for the kids. The attached pictures are what resulted.

After connecting the new cable to the plug, you will notice that the makers of some of these plugs have the cable entry cutout right in line with one of the screw holes. Make a new cutout by filing the aluminium with a round file *between* two screw holes (1). Fill the entire rear hollow part with glue; it takes exactly 3 sticks. After it has cooled, turn it over and hold the lid open (I used 2 kg hammers to do this) so that you can carefully fill the flap flush with glue.

Now comes the tricky, or tacky, bit. Wait for about 2 minutes and touch the glue to make sure it is not too tacky, but pliable. Then, press the lid down to make a depression and quickly pull it back (2). Do this a few times, so that the lid does not get stuck down. Once dry, it makes a good seal (3).

The procedure I have outlined covers the glue-filled female cap that is fixed to the vehicle. The fixing holes must be drilled out to hold the screws, of course.

Do the same for the male connection. Once the cable is connected, pull back the rubber gland and fill it with glue right up to the brim, even letting it overflow a bit. Then press the rubber gland over the hot glue.

Voilà... no more hassles with connectors when towing or caravanning.

CHARLES SEGAL  
AMANZIMTOTI



#### Keep it clean

Having to clean up the grinding, drilling and sawing debris around the workbench each time I tinkered around on the bench vice became a little tiresome. I bought a

150-litre geyser tray and positioned it under the feet of the bench. It catches all the fine filings and I can easily clean up previously hard-to-reach spaces.

Just remember not to trip on it. You don't want to sue yourself, now do you?

DRIES CORNELIUS  
CENTURION

#### How to avoid chips when drilling

When drilling a fairly large hole (5 to 12 mm) in veneer or melamine using standard high-speed drill bits, chances are that the edge of the hole will chip, ruining the finish of the drilling work. Start drilling with light pressure on the

## SEND US YOUR HINT - AND SCORE!

Send us your best home, garage, workshop and general DIY hints – and win! This month's best tip wins a Makita TM3000CX2 multitool with blades worth R3 449. This is the perfect all-round tool for serious home DIYers and industrial users alike, its slim body and narrow blades allowing for a multitude of uses where no other tool will fit. It comes with segmented saw blades (for cutting various materials such as wood, drywall, plastics, copper pipes and non-hardened nails), plunge-cutting saw blades, a flexible scraper with a narrow-tipped blade (ideal for removing window putty or scraping paint), a dust attachment set and a sanding pad. For further information on Makita power tools, visit [www.makita.co.za](http://www.makita.co.za)

#### Send your tips to:

PM Do It Your Way, Box 180, Howard Place 7450, or e-mail [popularmechanics@ramsaymedia.co.za](mailto:popularmechanics@ramsaymedia.co.za) Please include your name, address and contact number. Regrettably, only South African residents are eligible for the prize. Prizes not claimed within 60 days will be forfeited.



drill, using reverse mode. After the tip of the drill has entered the material for two to three millimetres, switch the drill to forward mode and continue drilling in the normal way. The edge of the hole will come out perfectly clean cut.

EBEN SMIT  
LITTLE BRAK RIVER PM

#### RESERVATION OF COPYRIGHT

The publishers of POPULAR MECHANICS reserve all rights of reproduction or broadcasting of feature articles and factual data appearing in this journal under Section 12 (7) of the Copyright Act, 1978. Such reproduction or broadcasting may be authorised only by the publishers of POPULAR MECHANICS. Published by RamsayMedia Pty Ltd for the Proprietors, POPULAR MECHANICS (SA) Pty Ltd, Uitylugt, Howard Drive, Pinelands, Western Cape. Distributed by RNA, 12 Nobel St, Industria West, Johannesburg, and printed by CTP Gravure, 19-21 Joyner Road, Prospecton, Durban. Apple Mac support: Digicape tel 021 674-5000.





# Popular Mechanics

12 ISSUES FOR ONLY R314

**SUBSCRIBE AND  
SAVE 25% - YOU'LL  
ALSO RECEIVE A CAPE  
UNION POLARIS LED  
TORCH FREE!**

The Cape Union Polaris is an ultra-bright torch featuring 9 LEDs wrapped in an aluminium casing.



**Plus FREE digital subscription!**

To extend your annual subscription for only R272 and receive all the benefits of the above offer, simply call 0860 100 205, quoting **14/12/SP/PM**

**HOW TO  
SUBSCRIBE**



[www.popularmechanics.co.za/  
subscribe](http://www.popularmechanics.co.za/subscribe)



**'POP' to 32698**  
R1,50 per SMS



[subs@ramsaymedia.co.za](mailto:subs@ramsaymedia.co.za)



**0860 100 205 tel**  
**0866 704 101 fax**

This offer closes 31 December 2014 and applies to print subscribers with a South African address only. Stock of the 9 cm LED torch is subject to availability and while stocks last. The model that you receive will be selected at random and may not be specified. It may also vary from the ones shown in the advert. Print subscribers can claim a FREE digital version – just contact us to confirm the email address for the link. For foreign rates and other great offers, visit [www.magsathome.co.za](http://www.magsathome.co.za)



# THE DISAPPEARING RHINO. IT'S A VIRTUAL REALITY.

South Africa is losing rhino on a daily basis through poaching. It's the most significant conservation issue faced by the country and time is running out.

At Investec, we couldn't just sit back and see this unique animal vanish off the face of the earth. In 2012, we set up Investec Rhino Lifeline which aims to raise awareness of the rhino crisis and respond through education, rescue and prevention initiatives. We're working with a number of trusted partners to make a difference, and we can do more with your support. Find out how you can help give the rhino a lifeline at **[investecrhinolifeline.com](http://investecrhinolifeline.com)**.

You can also donate directly to Rhino Lifeline:

Account name: The Wilderness Foundation Trust | Bank: Investec Bank Limited |

Branch name: 100 Grayston Drive | Branch code: 580105 | Account number: 10011642313 |

Please remember to include your reference based on the area of focus you are donating to (Rescue, Education, Prevention).

In partnership with

**WILDERNESS**  
FOUNDATION

